The Electrical Industry's Weekly Magazine

July 7, 1958

Electrical World

Price 50 Cents

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CIGRE Meets in Paris-Focuses on Transmission .. p 40

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UNIVERSITY MICROFILMS I
313 N 1 ST
ANN ARBOR MICH

Which—the Analog or Digital Computer? . . . p 53

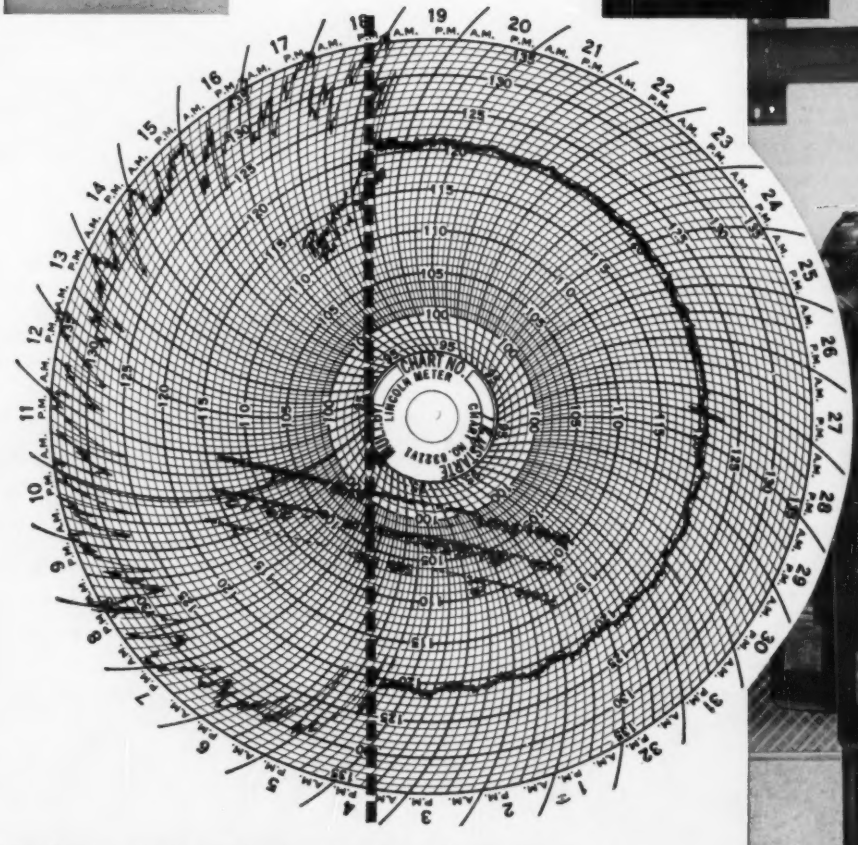
ALLIS-CHALMERS — 25 years of 5/8% step regulator leadership

Solution To:

High Voltage Problem

BEFORE

AFTER



Eliminate fluctuating voltages, burnouts, high voltage complaints by using Allis-Chalmers 5/8% step regulators

This actual chart illustrates how Allis-Chalmers regulators corrected these problems.

Whether your problem is high voltage or low voltage, take advantage of close control with the narrow 1 or 2-volt band width you can maintain using Allis-Chalmers step regulators.

For more information, call your nearby A-C representative, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Originators of 5/8% Regulators

ALLIS-CHALMERS

A-5711

Electrical World

Vol. 150, No. 1 JULY 7, 1958

Published for 84 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

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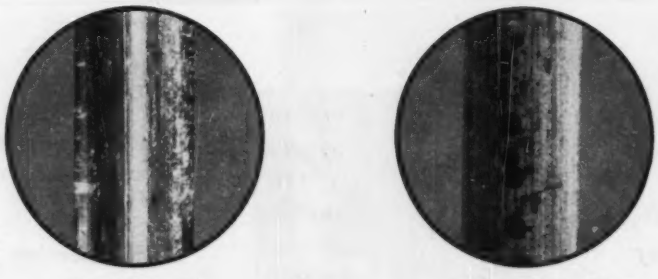
There is a Clear Relationship Between the Cleanliness of a Paper Cable's Components and its Ultimate Reliability . . .

Immaculate cleanliness is an absolute "must" in every aspect of paper cable manufacturing. Take, for example, Okonite's special attention to conductor strands. An extra operation cleans them prior to their being made into a conductor. Each wire is pre-cleaned—thoroughly "washed" and "scrubbed" before it enters the stranding machine. This process removes dust and metal particles, but most important of all it also removes the residual soap and tallow lubricants common to all wire drawing operations. Such impurities, when combined with a cable's impregnating oil, can cause deterioration of the paper insulation and subsequent failure of the cable.

R. C. Waldron
Manager of Engineering

Okonite's painstaking cleanliness measures, also, help maintain the original low power factor of Okonite Paper Cables. For this reason, even the metal binder tapes used in Okonite cables are thoroughly pre-cleaned—just the same as the conductor strands. In fact, every practical effort is exerted to make the components of Okonite Paper Cables as clean as possible.



cleaned strand — uncleaned strand

. . . might mean the difference between success or failure

Properly-shaped Sector Conductors Contribute to the Life Expectancy of Paper Cables

Since voids in a paper cable's insulation can cause cable failure, it is essential to eliminate every possible source of their occurrence. One source of "void" trouble is the shape of ordinary sector conductors. Because their flat surfaces make it difficult to wrap paper tapes tightly around them, the tapes do not "hug" the entire surface of the conductor. They tend to merely contact the flat areas "loosely" or not at all. Therefore, not only can voids develop between the flat surfaces and the first layer of insulation, but—due to the "slack"—they also tend to appear in the wall of insulation itself.

Realizing this flat surface "danger zone" existed in ordinary sector shape conductors, Okonite engineers designed conductor shaping dies that would form a continuous, convex surface about the entire circumference of sector conductors. As the accompanying diagram shows, the new Okonite sector design insured that each layer of paper tape would fit snugly around the conductor. Therefore, "danger zone" voids were effectively eliminated.

1. Carefully cleaning the cable's components, and
2. the development of an improved sector conductor . . .

. . . two concrete illustrations of the meticulous care that Okonite exerts over its paper cable manufacturing operations. This is all evidence to the fact that Okonite paper cables contain *added values*, values that are not written into specifications.

Today, every good engineer I know is seeking ways to get the maximum value out of the money he invests for his company or client. The *added values* in Okonite paper cables provide an opportunity to get extra life and dependability out of electrical cable systems. As one engineer to another, I urge you to become better acquainted with the long range economy of Okonite paper cables.

If you have not received your copy of the new Okonite paper cable catalog, or if I can be of help to you with a current problem, please get in touch with me at The Okonite Company, Passaic, N. J.

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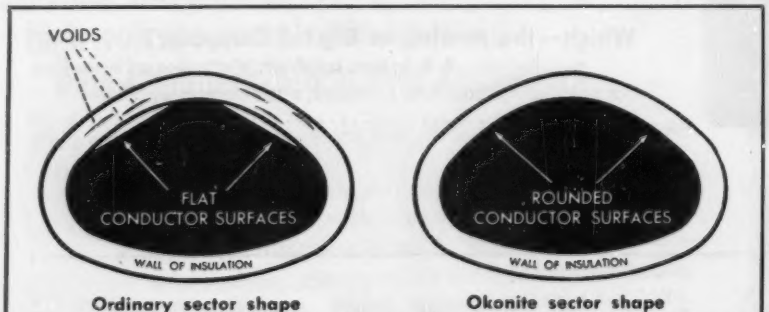

Ordinary sector shape

Flat surfaces . . . "slack" in paper tapes . . . voids . . . cable failure

Okonite sector shape

Continuous convex surfaces . . . snug fitting paper tapes . . . solid wall of insulation . . . long life, reliable service

***where there's electrical power . . . there's* OKONITE CABLE**

Capacity Reserves

The Federal Power Commission has recently issued another forecast of electric power requirements and supply of the United States to 1980. We welcome this thoughtful contribution to this field.

Fortunately, in certain respects, it reduces the confusion. In this case I am referring particularly to their treatment of capacity reserves.

In the F.P.C. report, they say "Over the past few years, reserves have been running at about 11 to 12 percent of peak load for the country as a whole. For the purpose of this particular study these reserves are gradually increased to 15 percent by 1980."

The peak loads to which capacity reserve is related are defined as "the arithmetical sums of the regional peaks." The highest of the twelve monthly peaks is used for each region.

This is certainly the correct procedure for reporting capacity reserves. We would like to see it adopted by all forecasters.

Fischer Black

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INTERNATIONAL **model AC-160** with Travel-Crew cab and public-utility body. Gross vehicle weight up to 33,000 lbs.

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NOW plenty of room for six! No crowding. Full-width front and rear seats measure five feet plus, door-to-door. Third door access to rear seat provides easy in-and-out. You move crew, materials and tools to job site in one operation, in all-weather comfort.

NOW save time and money! No need for the delays of field conversion to a crew cab. One order to your INTERNATIONAL Dealer delivers a factory warranted, work-ready truck with Travel-Crew cab for one low *complete-unit* price!

NOW factory-matched construction! Travel-Crew cab and chassis are designed one-for-the-other. Factory-matched on the assembly line to give you a truck that offers precision engineered weight distribution and well-balanced styling for smoother appearance and longer life.

cost least to own!

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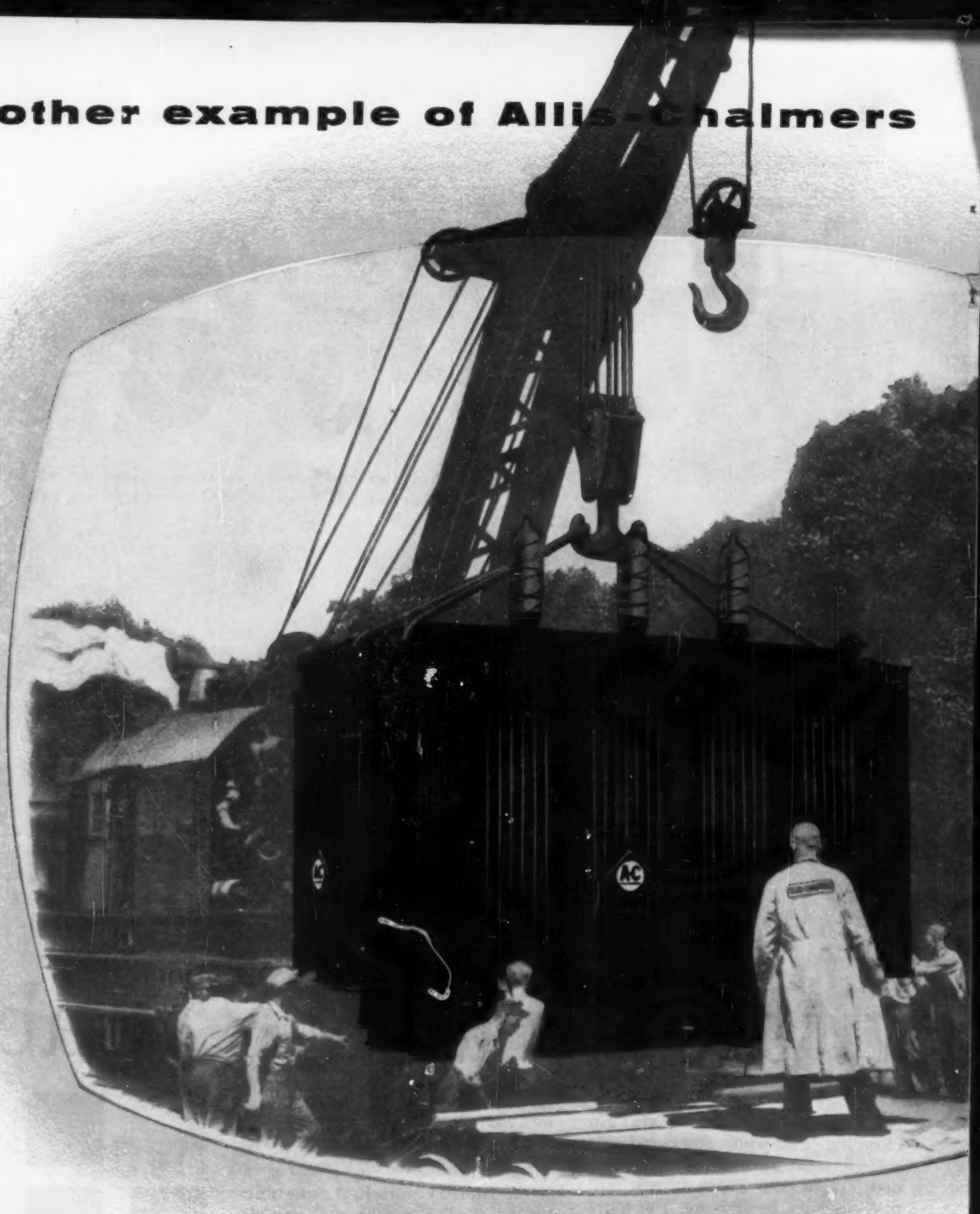
Construction Equipment • McCormick®
Farm Equipment and Farmall® Tractors

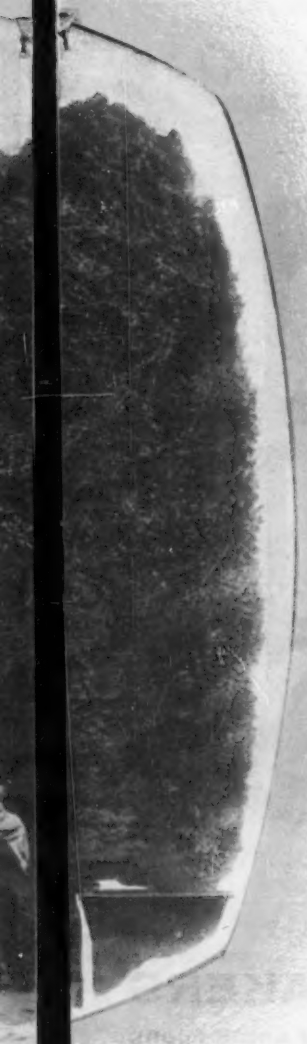
Another example of Allis-Chalmers



Balanced Design Once an Allis-Chalmers transformer is on the line, you can look forward to years of extra dependable service because *Balanced Design* includes: *Corona-Free* insulation, high impulse strength, uniform cooling, high short-circuit strength, weather-tight construction . . . and many other superior features. Ask your A-C man for all the details, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.

Welded-on radiators are pressure-tested at the factory. Bushings are also installed at the factory to reduce installation time.

leadership in transformers



Large factory-assembled transformers moved from train into position and...

on the line in less than 4 hours

A. J. Becker
Field Engineer

"MANY engineers are pleased to learn how quickly large power transformers can be installed. When you check the timesaving features of Allis-Chalmers transformers, the reasons for fast and easy installation become obvious."

Factory assembly where shipping clearances permit is one important reason. Factory-installed radiators and bushings leave nothing to be done at the site except grounding the tank, connecting high and low voltage bushings, and completing system electrical test checks. Building transformers as large as 20,000 kva using this construction has become routine at Allis-Chalmers.

Ski-base helps save time also. It permits rolling or skidding in any direction. Turned-up ski ends ride smoothly on all types of rollers without gouging or digging in. Eyeholes in the corners of the base make winching into position easy. Corner jack lugs are designed with ample clearance, and are clear of cooling tubes.

Another reason behind fast installation is the nation-wide staff of experienced Allis-Chalmers field engineers... like A. J. Becker, with 36 years of experience inspecting, testing and installing A-C transformers. These men *know* transformers. They offer on-the-spot guidance to make installation smooth and quick.

A-C ALLIS-CHALMERS

A-5694

Ski-shaped base of heavy I-beam cross supports permits moving in any direction. Reinforced clevis hole gives extra tow strength.

Ample jacking clearance and working space plus broad, flat surfaces for lifting jacks save hours of installation time.

FOR MORE DEPENDABLE CIRCUIT PROTECTION

FEDERAL PACIFIC
TYPE AF OIL CIRCUIT BREAKERS

...Designed to Interrupt High Current Faults in 23, 34.5, 46 and 69 KV applications

Compact...rugged...unrivaled in dependability—Federal Pacific's new high-capacity frame-mounted Oil Circuit Breakers embody the most advanced design features to provide unmatched performance and reliability. Employing a rugged, thoroughly-tested drop-bar contact structure, the new type AF is equipped with standard ASA bushings. Two bushing-type current transformers per bushing can be provided where necessary.

Powered by the advanced type OA hydraulic mechanism, they give fast, shock-free opening and closing...and are *100% trip-free under all conditions.* The mechanical linkage is characterized by a highly efficient straight-line-drive of greatly simplified design. Subjected to the most exhaustive testing procedure—the ability of the new breaker to withstand high-current fault interruptions has been thoroughly proved. For full details, call your nearest Federal Pacific engineering representative or write for Booklet #4-540: Pacific Switchgear Division, 5815 Third Street, San Francisco 24, Cal.

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FEDERAL FPE PACIFIC

Better Products to Control Electricity

The Electrical Week

FUTURE NEWS ▶ **An extension of the Medallion Home Program of LBE project** to the vast modernization market will get underway in the early fall.

LATE NEWS ▶ **Metal showered out of Britain's Calder Hall turbine room June 28** when new $750,000-machine disintegrated "through sheer centrifugal force" during test. Two reactors were undamaged.

Memphis sues TVA to cut its new wholesale power rates to the city. Rates rose almost 28% after contract expiration May 31.

State-seized Kansas City P&L and IBEW agree on 6% wage hike, retroactive to July 1, 1957. In other settlements: Niagara Mohawk and IBEW agree to 5% this June 1 plus another 5% June 1, 1959; Pennsylvania P&L grants 4.02% to Employees Independent Assn; Portland GE and IBEW, 4% retroactive to March 1; TVA, 5.3% to 6,000 salaried workers; and Detroit Ed and UWUA, 6¢ an hour.

A member of Hoosier Cooperative Energy, Inc, plans an 80-Mw plant at Army Engineers proposed Ohio River Navigation dam near Cannalton, Ind. Harrison County Rural Membership Corp has asked FPC for license, seeks REA loan. Part of power will go to Hoosier.

First G&T co-op in Kansas, Sunflower Electric Co-operative, gets certificate from State Corporation Commission. The group has borrowed $565,000 from REA to build a 22-Mw plant at Hill City. The plant will be leased to Central Kansas Power Co at Hays.

Mississippi PSC upholds "grandfather rights" of Singing River Electric Power Assn in dispute with Mississippi Power Co over service in six counties. PSC took "area" rather than "facilities" concept.

First full barge shipment of Kentucky coal for Tampa Electric Co reached its destination by way of New Orleans.

Management changes . . . Rochester G&E: R. Dewitt Pike to vp; Middle South Utilities: Harold F. Sanders to vp and secretary and Donald J. Winfield to treasurer; California E&P: Gerald H. Phipps to vp and treasurer, succeeding John G. Gilbert, retired; Quincy Electric and Weymouth L&P: T. Joseph Walsh to vp; Narragansett Electric: T. Dexter Clarke to vp; Montana Power: Sam B. Chase, senior vp and counsel; John W. Belanger becomes general manager of GE's Apparatus Sales Division, succeeding William V. O'Brien deceased . . . Corneille O. Strother is elected vp-research for Union Carbide Nuclear Co.

Due to the Independence holiday, which necessitated an advanced press schedule, this week's power output chart has been omitted. Information will be included in next week's chart.

CIGRE ▶ **The Russians indulged unreservedly in technical discussion** with the 1,800 engineers from 50 nations at the International Conference on Large Electric Systems. Long distance, high voltage transmission occupied the limelight at the 11-day assemblage, with the USSR playing a prominent role as world leader in the use of EHV. The Russians will adapt their 420-kv system to 500-kv operation without radical structural changes, achieving 40% more power transmission. USA excited considerable interest with announcement that corona and radio interference tests will be run on lines up to 750-kv **(p 40).**

EVENTS ▶ **AIEE met June 22-26** for its annual summer conclave: Picked Anaconda Veep L. F. Hickernell president for '58-59; conferred honorary membership on Deputy Defense Secretary Quarles; presented Lamme Medal to Dr Harold Black, inventor of negative feedback amplifier, and commemorated the first commercial installation of an ac electrical system **(p 37).**

ATOMIC ▶ **Protons, neutrons and electrons are crackling** in the heads of 20 Con Edison engineers as they prep for the A-age in the utility's two year program of tooling up for its Indian Point plant which goes on the line in '60. In addition to qualifying for AEC license, graduates will form a spirited cadre to spur an "intellectual chain reaction" as they return to their respective departments. More details of Con Ed program on **p 38.**

A $386 million Democrat backed atomic construction bill goes before the House soon. Despite the apprehensions of electric utility spokesmen, who see a dangerous reversal of government policy, chances are it will pass as is **(p 36).**

GENERATION ▶ **Two super critical turbines will go into operation** minus the usual sheet metal lagging structures covering high and low pressure units. Philadelphia Electric Co expects savings on capital, maintenance, and overhaul costs **(p 45).**

TRANSMISSION ▶ **Engineers have always run smack up against a thorny problem** when calculating impaired clearance under a transmission line with a broken conductor. A good man with desk calculator can come up with a solution in three days, but the same problem takes four minutes on an IBM 650 computer **(p 48).**

Hot-stick techniques and special clamps team-up to convert a 34.5-kv stub feeder to 69-kv suspension type line **(p 43).**

Tractor with front-mounted boom slashes pole setting time 2/3 in rugged terrain. After snaking poles through forest, crawling up 50% grades, pole setting dozer erects 70-ft poles with crossarms attached **(p 47).**

DISTRIBUTION ▶ **A practical use for surplus network transformers** has been found by Kansas City Power & Light Co; 300-kva units are installed as distribution transformers. The rectangular units are painted to blend well with modern residential design **(p 45).**

SYSTEMS ▶ **To calculate load flow problems,** which should it be—the analog or the digital computer? In the past the analog has reigned supreme, but the digital computer now offers attractive prospects. Costs per problem for both computers are nearly the same, ranging from $25-$200, however expense of the newer, digital method will decrease with experience. You'll find a blow by blow account of the analog-digital duel on **p 53.**

MANAGEMENT ▶ **Utility area development work has quintupled in ten years,** with at least 110 power companies now active. This growth is no surprise, since a utility can only prosper as its service area prospers. Today utilities offer plant location services from coast to coast, and many back community development programs to make their areas more attractive places in which to live and work. Here are three examples of area development at work: in Connecticut, the Midwest, and Hawaiian Islands **(p 73).**

SELLING ▶ **"Skyhook" lights cut glare,** minimize shadows at a multi-million dollar Chesapeake & Ohio coal handling yard. Stranded Copperweld cables suspended in pairs in spans up to 300-ft do the trick when outfitted with two-five 21,000-lumen mercury vapor lamps . . . Stubbornly viscous fluids get a boost on trip from outdoor storage tanks to plant when pipes are heated with an electric cable **(p 61).**

MANUFACTURERS ▶ **One of the longest lengths (2½ miles) of submarine power cable** ever produced will get a dunking in the Pacific. This 16.5-kv polyethylene cable will power off-shore drilling rig for Standard Oil of California . . . A 15-kv preassembled polyethylene power cable takes to the air in New England . . . Westinghouse Electric has purchased a sprawling 300-acre Muncie, Indiana, site for a power transformer plant . . . Unique combination of turbines powered by gas, steam and water, is now in operation at a Cordele, Georgia, power station . . . Multi-Amp Corp has developed an instrument for testing a wide range of power equipment and protective devices **(p 62).**

PEOPLE ▶ **Top executive promotions** have been announced by Minnesota Power & Light Co, as Axel H. Herbert steps up to vice president and general manager, while Hubbell Carpenter becomes vice president and chief engineer . . . At Southern Nevada Power Co a new vice president in charge of operations, Elmer F. Johnson, has been elected . . . Carroll H. Walsh has advanced to chief engineer at Arkansas Power & Light Co . . . Recently named purchasing agent at Dayton Power & Light Co, Ronald R. Wheeler **(p 82).**

A temperature-zoned reactor system might improve power economics by supplying heat at two different temperatures. The reactor core would consist of two zones that are neutron-coupled but isolated in temperature from each other. The high temperature heat could be used to superheat steam produced by the lower-temperature heat from the other zone.—**F. H. Clark and C. N. Klahr, Nucleonics, May 1958.**

TECHNICAL NOTES

Reactor fuses may soon be added to the list of nuclear safety devices. The fuse, storing a reactor poison (neutron absorber), is placed in a vacant fuel element space. When power level exceeds safe levels, the fuse's poison will shut down the reactor.

Potential of gas-cooled, graphite-moderated reactors designed for use of partially enriched fuel is significantly better than those designed for natural uranium fuel.

Metal-water reactions, possible in some types of nuclear reactor accidents, are slower than high explosive reactions, taking milliseconds rather than microseconds to attain peak pressures.

FROM EDITORS IN THE FIELD

High temperatures at some locations in power plants create problems with some hand-type fire extinguishers. Heat produces excessive pressure in carbon-dioxide units and tends to cake dry chemicals, according to investigations by Tennessee Valley Authority.

Hydraulic aerial baskets with booms insulated for 45 kv are used by Louisiana Power & Light Co for working 13-kv lines hot with rubber gloves. This practice has speeded up work enough to pay for the aerial devices in two years. It also permits older linemen to continue to do productive work.

Scooters are being used by operating personnel at steam stations to ride to wells and cooling towers 3,000 ft away from the boiler. Another time saver soon to be used by Gulf States Utilities Co is closed circuit TV panning of remote equipment in the station yard.

Be as careful in buying switch insulators as the ones out on your lines.

"Any insulator will do."

Is this what you say when you build an important power line? Then why say it when you buy the switches for that line? And it's the same as saying it if you don't ask for the insulator you want.

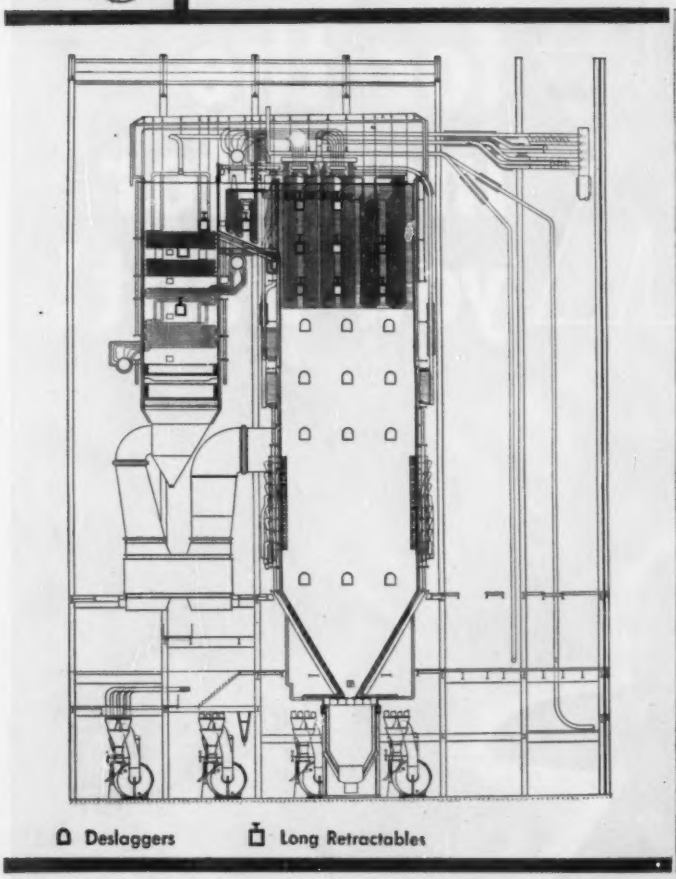
The facts are right in your own office -- your own information, gathered on your own terms, free from all suppliers' claims -- from which past performance of switch and bus insulators can be evaluated. Since they all cost about the same, life is the best measure of a good purchasing investment. If you explore your own records, the big chances are you will find O-B insulators have served you consistently the best.

To repeat this experience is easy. All it takes is a stroke of the pen on your switchgear orders. Ask for O-B -- by name!

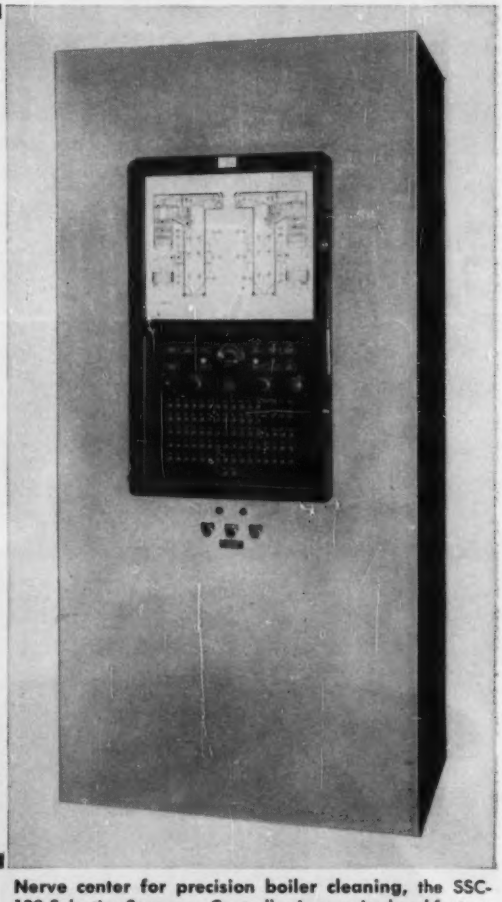
OHIO BRASS COMPANY, MANSFIELD, OHIO
Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

Ohio Brass

4907-H



Showcase super-critical steam generator will be equipped with a Selective-Sequence System that includes Vulcan T-30 long retractables with 38 to 37-foot travels, half 'tracts with 19-foot travels. Wall deslaggers and air-preheater cleaner controls will also be used.



Nerve center for precision boiler cleaning, the SSC-120 Selective-Sequence Controller is pre-wired and factory assembled for positive control. It handles up to four cycles for each blower. A 60-station model is also available.

Vulcan soot blowing system saves steam, air and manpower

A Vulcan Selective-Sequence System gives the operator the ultimate in finger tip control of *individual* soot blowers. He can set up a sequence to assure thorough boiler cleaning and forget it. He can monitor the program at a glance, stop it, restart it or change any soot blower from any point in the sequence to another to improve cleaning or conserve the blowing medium. Here's complete flexibility without extensive time consuming wiring and piping changes.

Besides Selective-Sequence, Vulcan also builds Automatic-Sequential Systems that can use steam and/or air without a change in equipment, and can provide both simple automatic or manual control.

A complete line . . . a complete service

Over 50 years of design experience backs Copes-Vulcan's broad line of control systems for boiler cleaning, combustion, feed water, pressure reducing and desuperheating.

Whether furnished in individual units or integrated into a single system, each installation gets custom design, skilled continuing service. Trained service men help set up a routine inspection-maintenance program . . . visit each installation periodically.

Bulletin 1029 details Vulcan Automatic Soot Blowing Systems. Write for your copy today.

Copes-Vulcan Division
BLAW-KNOX COMPANY
Erie 4, Pennsylvania

NEXT WEEK

An important announcement of advancement in product design and performance.

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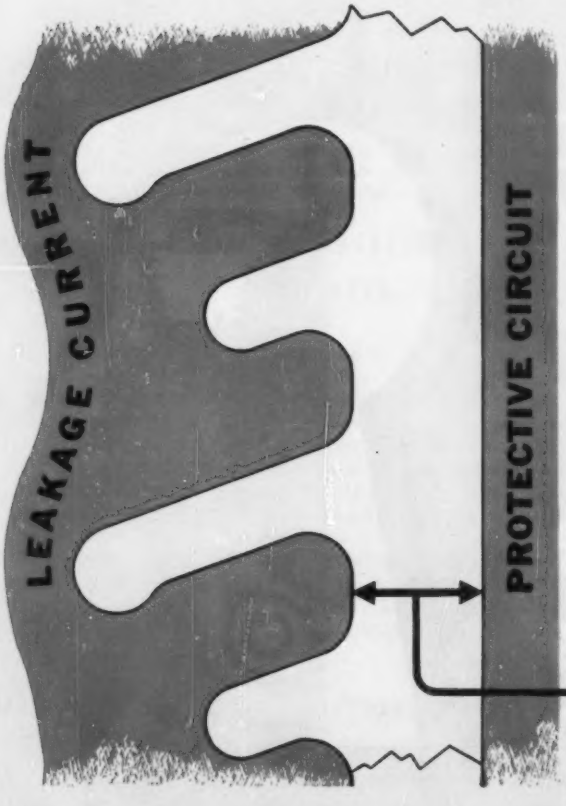
MOLONEY ELECTRIC COMPANY

Manufacturers of Transformers for Utilities, Industry, and Electronic Applications

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA

Contamination Defeated at its

Single-Unit Construction of Thorex Arresters Renders Leakage Currents Harmless



A thick wall of wet ware electrical porcelain stands between damaging surface leakage currents and the sensitive internal protective circuit in Thorex Dynagap Type MPR lightning arresters. This insulating barrier is continuous from line to ground at all voltages. Only Thorex uses this highly practical approach to the elimination of surface leakage current damage.

Nothing could be more simple -- nothing more positive!

Heavy external leakage currents, resulting from severe contamination, are often present on the surface of a lightning arrester. When these are superimposed on the sensitive internal protective circuit, damage can result. To cure this trouble most effectively, keep the two apart!

How can they become combined? Via the metal end caps which are electrical terminals for the internal protective circuit of each unit and are, naturally, near leakage current potential. In multi-unit arrester construction, electrical paths from the outside to the inside -- admitting leakage current into the protective circuit -- exist at each inter-

Problem Source!

mediate unit connection point in the stack.

How are these two currents now separated? New high voltage Thorex Type MPR arresters are single-unit construction at all voltages. Radial porcelain insulation is continuous from line to ground. No intermediate unit end fittings are present to convey surface leakage current to the internal protective circuit. These leakage currents merely bleed harmlessly to ground.

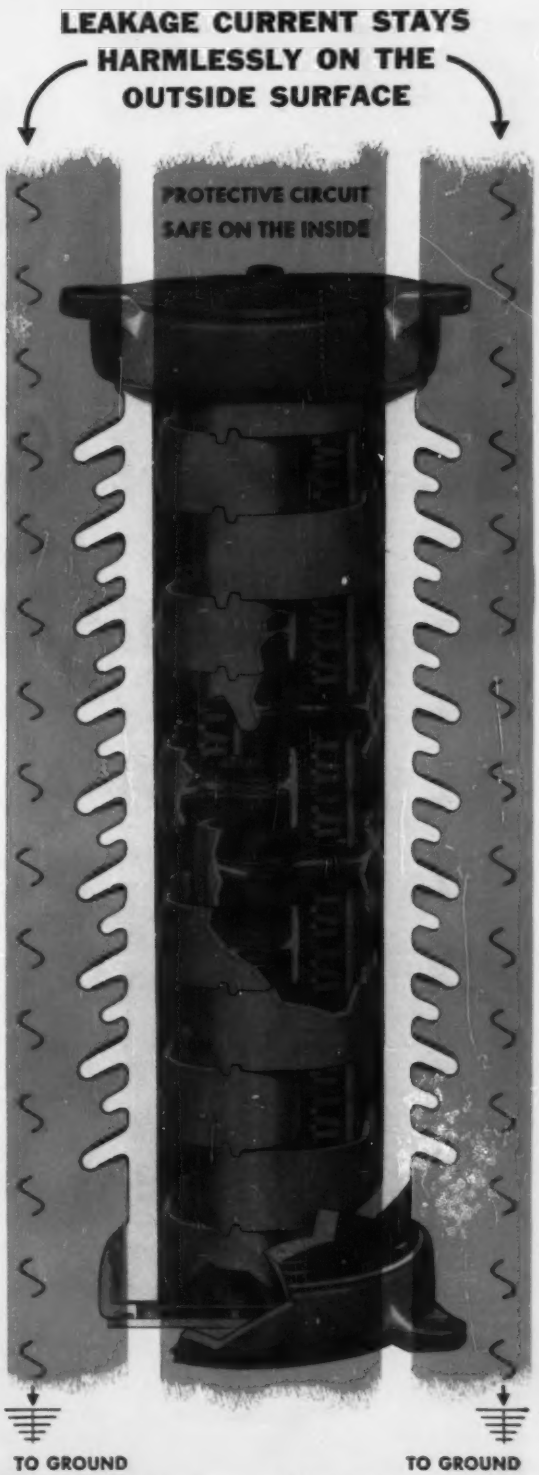
The result -- by insulating the leakage circuit from the protective circuit, the contamination problem has been defeated at its source, without the need for any kind of complex design.

This basically simple and highly effective feature is exclusive with Thorex Dynagap Type MPR lightning arresters for operating voltages of 69 kv and above. In all other respects -- especially that of surge current durability -- these arresters are equally outstanding. Put new Thorex Dynagap arresters *on your stations*, and *off your mind!*

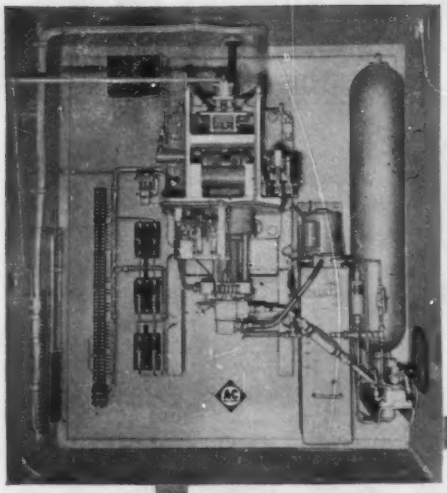
OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass

4908-H



Safe on the inside! The sensitive arrester protective circuit is insulated by a heavy continuous wall of electrical wet ware porcelain. Its thickness is dictated by mechanical requirements. Its insulating qualities are far beyond adequate. Surface leakage currents remain on the outside and bleed harmlessly to ground. Only in Thorex lightning arresters will you find this basically simple, positive protection against contamination damage.



High-speed Pneu-Draulic operator gains overwhelming user confidence

Seldom does a drastic change in product create such universal user acceptance as the *Pneu-Draulic* operator during the past three years. Fully 98 percent of Allis-Chalmers breaker customers now specify *Pneu-Draulic* operators.

How solid is their confidence? More than half have placed repeat orders! They've proved to themselves that this high-speed closing device, plus *Ruptor* interrupter and mechanically trip-free operation, is the right combination for safe, dependable breaker performance.

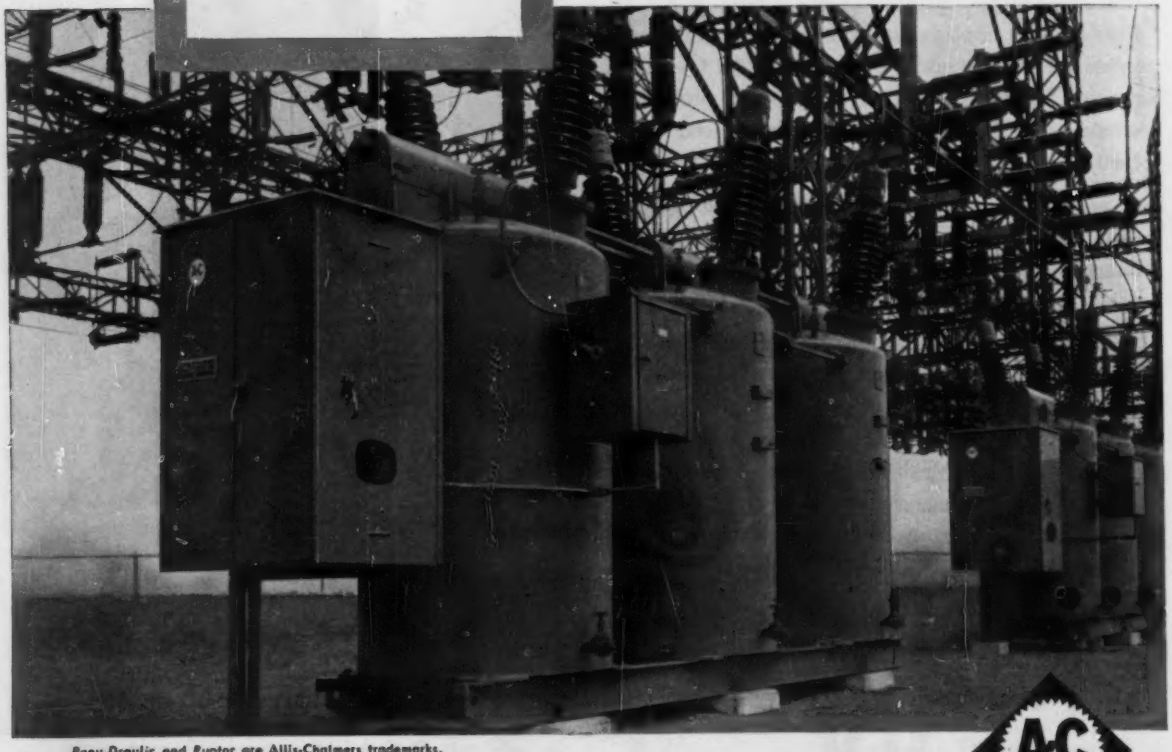
You'll be convinced, too. Call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

98% acceptance!

Why a Pneu-Draulic System?

- Compact design with few moving parts.
- *Pneu-Draulic* system filled with oil, eliminating rust, freezing, corrosion.
- Safe emergency closing at full rated speed onto energized line, *even when no control power is available.*
- Complete system protection with mechanically trip-free operator mechanism.

For outdoor oil circuit breakers rated 14.4 kv, 500 mva and larger.



Pneu-Draulic and *Ruptor* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5684

TIME IS THE MEASURE OF ALL WOOD PRESERVATION

Utility pole, railroad tie or prized fly rod – the question of wood preservation is important.... The answer for industry – proved by over 50 years of service records – is AMCRECO pressure treatment.

AMCRECO
PRESSURE TREATED WOOD PRODUCTS

AMERICAN CREOSOTING CORPORATION LOUISVILLE 2, KENTUCKY
SUBSIDIARY OF UNION BAG-CAMP PAPER CORPORATION

I HAD THE BOSS UP A POLE...

"He knew all about the operating advantages of polyethylene coated wire . . . but I took him up and showed him why I liked it and why it's saving the company even more money than he figured."

In the past 12 years polyethylene covered line wire and cable have chalked up outstanding service records for utilities. But some of the best reasons for using polyethylene coatings don't turn up in operating statistics —they come from the men whose job it is to install and maintain the lines . . . Reasons such as these:

Polyethylene Is Easier to Install

It's free stripping, yet has excellent adhesion and will not ruffle over cross arms. It's clean to work with and its surface is "slippery" too. Polyethylene coating is lighter than other types of covering . . . it handles easier.

Polyethylene Covered Line Wire Saves Outages

Polyethylene forms a complete and permanent covering over line wire. That means fewer outages from contact with trees, wind-blown swinging wires and foreign objects. Smaller diameter polyethylene coatings offer less wind resistance above ground. Lighter weight can be an advantage, too, in ice storms.

In field servicing . . . in over-all performance and service life—polyethylene has proved its superiority in wire and cable applications such as these:

- Line wire covering
- Power cable dielectric
- Tree wire covering
- GTO (Neon Sign) Cable
- Coaxial Cable
- WD-1 Infantry Field Wire
- Control cable insulation and jacket
- Communication cable insulation and sheaths
- Corrosion protection for metal sheaths.
- TV Lead Wire

When you order polyethylene covered wire and cable, ask your supplier about the superior weather and stress crack resistance of polyethylene made with PETROTHENE® polyethylene resins. PETROTHENE quality costs no more.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in principal cities

Makers of PETROTHENE Polyethylene Resins

Photo by Morton

Niagara Mohawk Power Corp. Huntley Generating Station 230-kv Switchyard. Three-inch S.P.S. Alcoa Tubular Aluminum Bus with welded Alcoa Tee Connectors from bus to lightning arrestors.

ALCOA RESEARCH

. . . development today for tomorrow's loads

HOW ALCOA BRINGS NEW ECONOMY TO MODERN SUBSTATIONS

ALCOA ALUMINUM BUS AND WELDED BUS FITTINGS: A NEW ERA IN SUBSTATION CONSTRUCTION COMES OF AGE

Photo by Morton

Florida Power & Light Co. Sanford Substation. Two and one-half inch S.P.S. Alcoa Tubular Aluminum Bus with welded Alcoa Vee and Angle Tee Connectors making "A" frame connections.

Many of the major developments in the evolution of the modern substation are results of research and development begun by Alcoa over half a century ago. Alcoa's experience with bus conductors, fittings and other substation equipment had its beginning in 1895 at Niagara Falls, New York. After studying an application in one of Alcoa's own plants, where flat aluminum bar was used to supply large amounts of power for electrolytic processes, Alcoa researchers were quick to recognize the tremendous economies it could offer utilities. Work began at once on such problems as temperature limitations, voltage drop, power losses and the effects of short circuit forces. Today, most of these problems have been solved. But work continues in order to meet challenges of changing design and demands for increased size and more economical construction prompted by the rapid growth of the electrical industry.

Typical of the results of this continuous program of research was the introduction by Alcoa of welded aluminum bus fittings. Much quicker and easier to install—particularly in those installations where many joints, taps and fittings are required—they also give a neat, compact appearance. They resist corrosion and provide added strength and durability that cut maintenance to a minimum. In the more than ten years since their first application, Alcoa welded aluminum bus fittings have saved utilities millions of dollars in construction and maintenance costs. With substations going up at a record pace, future savings should be even greater.

Credit for the development of welded aluminum bus fittings and many other innovations in substation construction and equipment must be attributed to the teamwork of Alcoa's research, electrical design and electrical operating people in cooperation with many farsighted customers who so willingly joined the pioneer ranks. Years of arduous research at Alcoa's Process Development Laboratories went into welding techniques; only then were Alcoa researchers satisfied that they had a product thoroughly sound—mechanically and electrically. Even now, after more than ten years of successful operation in the field, work continues with a single aim: to provide customers with still better products . . . and still greater economies.

Photo courtesy Public Service Electric and Gas Company

Public Service Electric and Gas Company Linden Generating Station. 18-kv load is transferred from isolated phase generator leads to 11-inch Alcoa Integral Web Channel Bus through welded flexible conductors.

ALCOA ALUMINUM
ELECTRICAL CONDUCTORS AND ACCESSORIES

ALCOA RESEARCH

. . . development today for tomorrow's loads

FURTHER ECONOMIES THROUGH MAINTENANCE REDUCTION AND FASTER INSTALLATION ARE GOALS OF ALCOA SUBSTATION RESEARCH

Aluminum Company of America. Wenatchee Plant Substation. Alcoa I-Beam suspended bus, with tubular bus taps mounted on aluminum structural members.

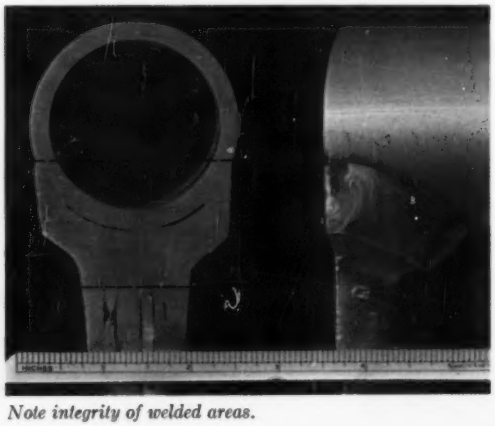
The results of Alcoa's continuous teamwork have already paid off with such major developments as integral web channel bus, universal angle bus, welded aluminum bus fittings and many other important innovations which have increased dependability and lowered costs. Today, Alcoa is still looking for better answers to substation problems in a number of important areas.

Maintenance Reduction—Aluminum substation structures never require painting, thus eliminating troublesome power interruptions for this routine chore. Welded connections are as maintenance-free as man knows how to make.

Faster Installation—Aluminum bus conductors and aluminum substation structural members both contribute measurable savings in construction time. The use of aluminum in the substation structure permits grounding of the structure base only, thus eliminating separate equipment grounds. Welded bus fittings may be assembled easily on the ground. The aluminum bus itself is light and easy to put in place.

As in the past, you can look to Alcoa for continued leadership in producing the most modern and dependable line of aluminum products available anywhere for the electrical industry.

Cross section of tap from tubular aluminum bus to stranded aluminum conductor. Weld is first made joining aluminum strands to inside socket of "top hat" connector. Then a fillet weld is made to join welded assembly to tubular bus.



Note integrity of welded areas.

Your Guide to the Best in Aluminum Value

ALCOA ALUMINUM
ELECTRICAL CONDUCTORS AND ACCESSORIES
ALUMINUM COMPANY OF AMERICA

"ALCOA THEATRE"
Exciting Adventure
Alternate Monday Evenings

THE PEACEFUL ATOM

...a sound investment for increasing power requirements

15 Utility Companies Underwrite Study For Advanced Nuclear Power Reactor For the Southwest

Up from the Texas Panhandle... through the oil fields of Oklahoma... across the Kansas prairie... over the Ozarks of Arkansas and Missouri... and down through the rich bottom land of Mississippi and Louisiana stretches a vast network of electric power lines and generating stations. Through this vital system surges millions of kilowatts of power... lifeblood of the Southwest's cities, farms and factories.

The bulk of this power (6,250,000 kw) is generated by fifteen investor-owned utility companies. Recently these firms made a decision that brings peaceful atomic energy into an important new phase.

Planning together as the Southwest Atomic Energy Associates, they signed a multi-million dollar contract with Atomics International to develop an advanced reactor concept for full-scale atomic-electric power stations. The new project is called AETR (for Advanced Epithermal Thorium Reactor). It promises to be economically competitive with power plants that depend on diminishing, increasingly expensive conventional fuels. Studies will be directed toward the design of a nuclear power plant of 200,000 electrical kilowatts.

NEW POWER FOR THE SOUTHWEST
Fifteen companies pool resources to develop an advanced power reactor

Interest in the project is indicated by a roster of the new group's member companies: Arkansas Power and Light Co., Arkansas-Missouri Power Co., Central Louisiana Electric Co., Inc., Empire District Electric Co. (Mo.), Gulf States Utilities Co., Kansas Gas and Electric Co., Kansas Power and Light Co., Louisiana Power and Light Co., Mississippi Power and Light Co., Missouri Public Service Co., New Orleans Public Service, Inc., Oklahoma Gas and Electric Co., Public Service Co. of Oklahoma, Southwestern Gas and Electric Co. (La.), and Western Light and Telephone Co., Inc. (Mo.).

SEVEN STATES MAP OUT A PLAN FOR ATOMIC ELECTRICITY

Hardware in Action. AI has built and is now operating two other nuclear power reactors as part of the AEC's program for economical power from atomic energy. One of these is the Sodium Reactor Experiment (SRE) which is supplying nuclear heat to operate an experimental electric power plant installed by the Southern California Edison Co. The SRE is providing technical data and experience for the design of full scale electric stations, such as the 75,000 kw plant for Consumers Public Power District of Nebraska.

AI's Organic Moderated Reactor Experiment (OMRE) has been operating at the AEC's National Reactor Testing Station in Idaho Falls since last September. It has provided technical and economic information for the construction of OMR power plants now planned for the City of Piqua, Ohio, and large network installations under consideration for this country and abroad. Atomic propulsion systems for supertankers and merchant ships are another important OMR application.

In addition, Atomics International research reactors are helping to bring "Atoms for Peace" to the free world. These reactors are now operating in Japan, Germany, Denmark, and the United States. Another is under construction for Italy.

Nuclear Power Abroad. AI works with leading companies overseas. With DEMAG, one of West Germany's largest heavy manufacturers, AI has formed INTERATOM, a jointly owned subsidiary headquartered in Duisburg. AI has a technical assistance agreement with ASEA, a prominent Swedish electrical firm with offices in over 50 countries.

ATOMICS INTERNATIONAL, P.O. Box 309, Canoga Park, Calif. Cable Address: ATOMICS.

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.
PIONEERS IN THE CREATIVE USE OF THE ATOM

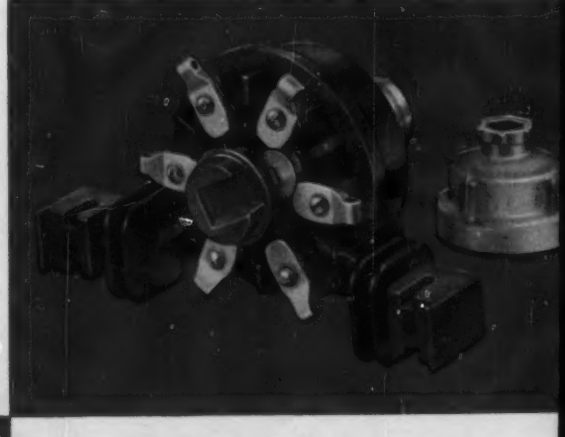
.....if you use

Eliminate costly, time-wasting, dangerous steps

with the externally-

RT & E TAP

The industry—famous RT & E Tap Changer has been redesigned, and repositioned on the tank, for even greater ease in tap setting, speed and convenience in changing tap positions.



FAST 1-2 ACTION

STEP 1
Remove screw-on type cap. Note husky, hand-size gripping area.

STEP 2
Reverse cap and use as handle. That's all there is to it!

The new RT & E tap changer body is molded in one piece, multi-skirted for long creepage and high surge strength. Material used is electrical grade, wood-flour filled phenolic of high thermal stability. Contact is made through a bridging roller, under spring pressure, especially grooved around the periphery to provide double contact surfaces. This assures low resistance and cool operation.

taps

Do it faster, safer, more economically

dependable operated

CHANGER

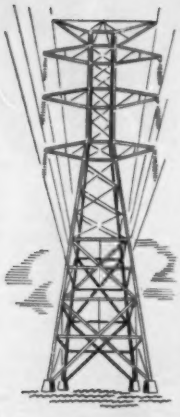
- No handhole cover to remove!
- Reduces danger of tank breathing!
- No lengthy expensive, tap changing time!
- No confusion on tap setting!
- No danger of oil contamination!

Ask your RT&E representative to demonstrate the RT&E Tap Changer or write for complete details to . . .

Engineering Talent
Concentrated on One Idea—
A Better Transformer!

RT&E CORPORATION

WAUKESHA, WISCONSIN • PORTLAND, OREGON



STEEL TOWERS a Bethlehem Specialty

SKILLED ENGINEERS plan production of your towers and switchyard structures. Their detail drawings assure accurate, efficient fabricating. They tell our shopmen exactly where to punch and shear . . . to within 1/32 inch! Takes good men and good tools to do this kind of job.

RACK PUNCHES (shown here) as well as tandem and cluster punches are among the *specialized* equipment necessary. Holes must be accurate in position and size—they can't be reamed after galvanizing. There's all the difference in the world between tower work and ordinary structural fabricating.

GALVANIZING protects the steel from corrosion. The pieces are thoroughly cleaned, pickled, immersed in an electrically controlled zinc bath, then quenched. We do our own galvanizing, of course. All three Bethlehem tower shops are equipped with the latest word in galvanizing facilities.

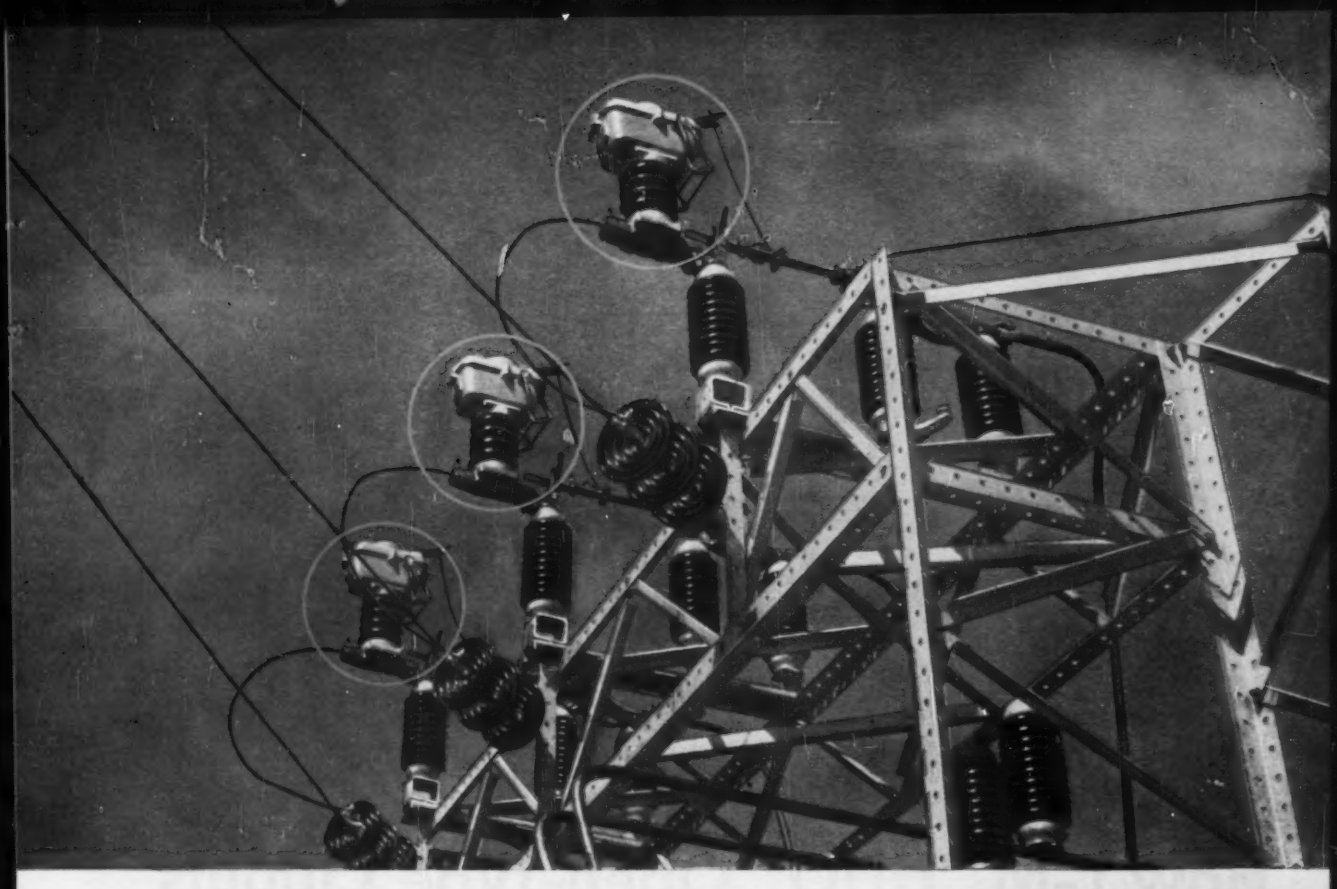
FINISHED STEEL is carefully sorted in the shipping yards. You receive each individual tower "package," including fasteners, ready for speedy erection in the field. Our tower-fabricating works at Leetsdale, Pa. (near Pittsburgh), South San Francisco, Calif., and Seattle, Wash. are strategically located to fill your tower and switchyard requirements. May we quote on your next job? Please contact the Bethlehem sales office nearest you.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL



THE NEW L-M OIL INTERRUPTER provides high-speed circuit interruption on sub-transmission circuits without external arc or flame. The unit costs less than half as much as other interrupters for the same application.

New High-Voltage Oil Interrupter For Only $290 Per Pole for 69 kv

Units cost less than half as much as other interrupters for the same application—$240 per pole for 23 kv and 34 kv, $265 per pole for 46 kv, and $290 per pole for 69 kv.

Now you can get an economical, high-voltage oil interrupter for sectionalizing and switching on sub-transmission circuits. The unit is capable of interrupting load currents, line charging currents, and transformer magnetizing currents. It easily meets NEMA and AIEE standards, including the ice test.

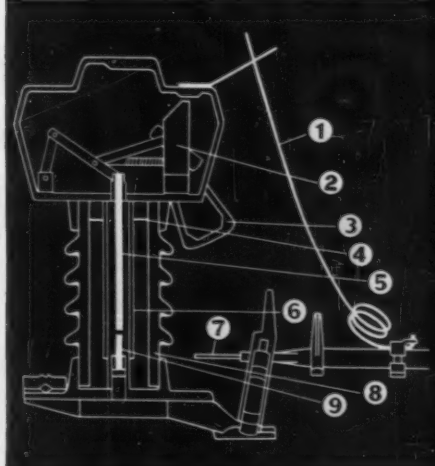
Contacts Separate At High Speed

The L-M interrupter consists of an oil-filled unit housed in a porcelain insulator, and a rod to shunt the current through the interrupter while the main switch blade is being disconnected. As the switch blade rises, it engages a spring trip lever which rises to over-toggle position, causing the contacts within the unit to separate under oil at high speed. The speed of the moving contact is independent of the operation of the main switch blade.

Contacts have long-life copper-tungsten arcing tips. All linkages are made of aluminum for lightness and fast operation. A simple fiber-washer arrangement provides a spiral passage for the pressure-generating arc, forcing oil and un-ionized gas around the arc core as the moving contact is withdrawn. This assures rapid arc extinction at low current values.

Ratings 23 kv Through 69 kv

L-M's new interrupter is available in 23, 34.5, 46 and 69 kv ratings. Continuous current rating is 600 amperes; momentary and short-time current ratings are 40,000 amps. for 10 cycles, and 25,000 amps. for 4 seconds. The unit can be installed on any of L-M's PV switches without altering the original parts. The addition of the interrupter does not change the electrical clearance or the phase spacing of the switch.



Cutaway View of Oil Interrupter

1. By-pass rod
2. Toggle mechanism
3. Trip lever
4. Oil level
5. Moving contact
6. Interrupter
7. Trip rod
8. Bushing
9. Stationary contact

Get Complete Information

Ask your L-M Field Engineer for more complete information on L-M's new high-voltage oil interrupter and on L-M's outstanding power switching equipment. Or write Line Material Industries, Milwaukee 1, Wis.

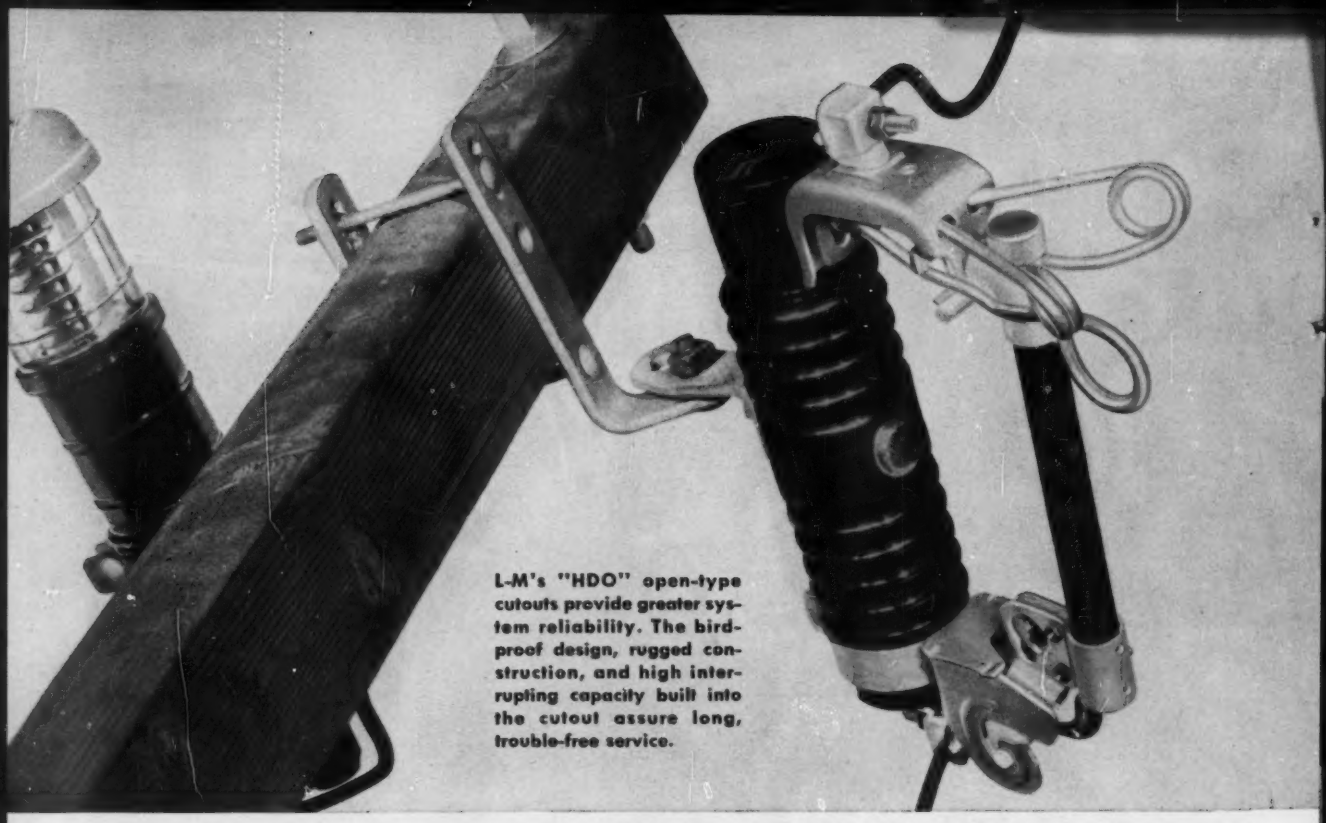
317

LINE MATERIAL Industries

McGRAW-EDISON COMPANY

LM Power Switching Equipment

McGRAW-EDISON



L-M's "HDO" open-type cutouts provide greater system reliability. The bird-proof design, rugged construction, and high interrupting capacity built into the cutout assure long, trouble-free service.

How L-M "HDO" Open-Type Cutouts Handle Both High and Low Faults

L-M's controlled double-venting principle provides positive pressure control—an outstanding advance in fuse cutout design.

by **M. L. FENNIG**
Sales Application Engineer,
Protective Equipment,
Line Material Industries

Fuse cutout design has always been something of a compromise. To assure expulsion of arcs from low-amperage faults, the tube must provide small volume to build ample pressure. Yet this same tube is subject to sudden rupture from the rapid development of large gas volumes from high-amperage arcs. L-M's controlled double-venting principle provides the best solution to this problem known at the present time.

Positive Pressure Control

A unique feature of L-M's "HDO" cutout is the pressure-controlled double-venting cap. On low-amperage faults, gases are vented from the bottom of the tube only. This allows sufficient pressure to build up in the tube to assure consistent, reliable arc interruption of faults of the smallest magnitude.

On high-amperage faults, where pressure relief is needed, the diaphragm in the heavy-duty cap opens at the top to allow double venting. The double venting reduces the stress on the cutout, eliminating the possibility of bursting the tube on high-amperage faults. This assures dependable operation, and greater safety for the lineman. Gases from the top are vented vertically to avoid gases from the bottom. This minimizes possibility of contact flashover.

L-M's "HDO" cutouts are strong, durable and easy to operate. They provide the greatest system reliability and lowest operating and maintenance cost of any cutout on the market today. Here's why.

Lower Resistance Path

All current-carrying parts are made of heavy-duty solid copper or copper alloy and are silver-plated to assure cool operation even after many years of service. In addition, the "HDO" has a minimum number of current-interchange points in the circuit, from line lead to the load lead. This provides ample capacity without overheating for years to come.

Greater Resistance to Corrosion

L-M uses high-strength, low-alloy corrosion-resistant steel, such as Cor-Ten, for all non-current-carrying parts, except the hanger. Cor-Ten steel has a yield point at least 1½ times that of structural steel and about twice that of mild carbon steel. Its ability to withstand atmospheric corrosion is 4 to 6 times greater than mild steel.

The results of a 16-year test, shown in the curves, prove the superior corrosion resistance of the low-alloy corrosion-resistant steel hardware furnished with L-M's "HDO" cutout.

Other Outstanding Features

- The "HDO" offers many other desirable features:
- Top contacts and center hanger mounting have through-bolts with insulated heads to provide complete bird-proof protection.

LINE MATERIAL Industries
McGRAW-EDISON COMPANY

Distribution Class Single Insulator Type

L-M's standard mounting "HDO" cutouts are rugged, easy to operate with hook-stick. All current-carrying parts are silver-plated to assure cool operation.

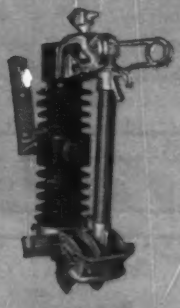
Two Insulator Type

Distribution post insulator mounting of L-M's "HDO" cutouts provides additional creepage distance for applications in industrial and coastal areas.

Complete Line of Open-Type Cutouts from 5.2 kv to 27 kv

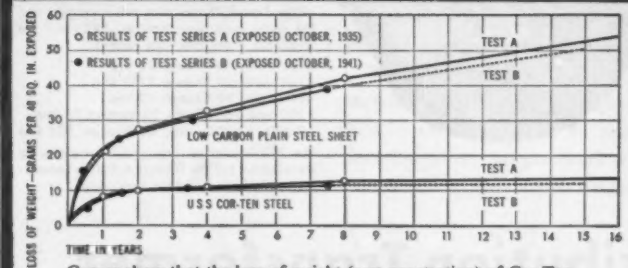
Power Class

Substation mounting is also available. L-M's "HDO" cutouts provide high interrupting capacity, economical fuse replacement, easy operation with a hook-stick and long life.



Load Break

Easy pulling action of interchangeable load-break cartridge will break the link. Arc interruption is completed inside the tube, assuring fast, safe switching of either inductive or capacitive load currents. Available in 5.2, 7.8, 15 and 27 kv ratings.


LOSS OF WEIGHT—GRAMS PER 40 SQ. IN. EXPOSED
TIME IN YEARS
○ RESULTS OF TEST SERIES A (EXPOSED OCTOBER, 1935)
● RESULTS OF TEST SERIES B (EXPOSED OCTOBER, 1941)
TEST A
TEST B
LOW CARBON PLAIN STEEL SHEET
TEST A
U.S.S COR-TEN STEEL
TEST B

Curves show that the loss of weight (rust penetration) of Cor-Ten high strength steel is one-fourth that of carbon steel and about one-third that of copper steel after 16 years exposure to *severe* industrial atmospheric conditions. Steel of this type is used for all non-current-carrying parts of the "HDO" except the hanger.

COR-TEN is a registered trademark of U. S. Steel Co.

SIZES AND RATINGS

Cartridges	Interrupting Capacities, Amperes 5.2 KV	7.8 KV	15 KV	27 KV
Normal-Duty Single Venting (Solid Cap)				1200 A.
Heavy-Duty Double Venting (Heavy-Duty Cap)				4000
Heavy-Duty Single Venting (Solid Cap)	5000	5000	4000	
Extra-Heavy-Duty Double Venting (Heavy-Duty Cap)	10000	10000	8000	

- All cartridges are designed for easy hook-stick removal and replacement.
- Top contacts are husky, hard-drawn copper, silver-plated. They serve as guides so the tube cannot miss top contacts.
- Cartridge is firmly anchored; the tube cannot move upward, even when it is accidentally closed in on a fault, within its rating.
- Cutout interrupts any fault current, from minimum melting of link to maximum interrupting capacity of cutout, *with any size link.*

Complete Line of Cutouts

L-M offers a complete line of cutouts in 5.2, 7.8, 15 and 27 kv classes, with a full line of fuse cartridges in normal, heavy, and extra heavy-duty interrupting rating, switch blade, and interchangeable load-break cartridges. All cartridges (except the 27 kv) use standard 20-inch distribution fuse links.

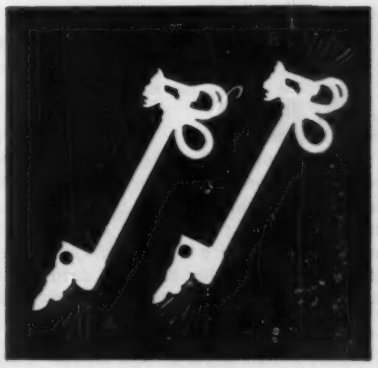
Interchangeable Load-Break Cartridge

Line Material's "HDO" open-type cutout has optional interchangeable load-break cartridges available in each voltage class and interrupting rating.

A pulling force of less than 30 pounds is required to break the largest size link. The cartridge is designed to interrupt all capacitive and inductive loads up through 100 amperes and to completely extinguish the load current in the tube. With L-M's simple load-break device you can switch loads or sectionalize distribution circuits quickly and easily with very little increase in your cutout investment.

Get Complete Information

Ask the L-M Field Engineer for bulletins and complete information about L-M's full line of open and enclosed fuse cutouts and other protective equipment. Or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: Canadian Line Materials, Ltd., Toronto 13, Ontario.



How Double Venting Controls Pressure

On low-amperage faults, ample pressure is provided to insure fast arc extinction, by single venting at the bottom of tube, *A*.

On high-amperage faults, heavy-duty cap at top (*B*) opens so that pressure is vented at both top and bottom of tube, providing greater safety by eliminating tube rupture. Note that the gases from the top are vented vertically—not horizontally. This eliminates danger of contact flashover.

fuse cutouts and fuse links

McGRAW EDISON

Actual utility company load curve on a transformer for an August week.

With SRT, voltage would have been kept within the band width (blue lines)

"X-ray" view of the SRT—showing the exclusive L-M regulating mechanism at the top of the Round-Wound core-coil assembly, and the under-load tap changer. SRT's will be available in the following ratings:

2400 volts, 10 through 25 kva
4160 volts, 10 through 37½ kva
4800 volts, 10 through 50 kva
7200 and 7620 volts, 10 through 75 kva
12,000, 14,000 volts, 10 through 100 kva

The SRT is another outstanding engineering development of the Thomas A. Edison Laboratories of McGraw-Edison Company.

HERE is L-M's New SRT the World's First Self-Regulating distribution Transformer

Provides regulation at the point of use; corrects overvoltage and undervoltage in four 2½% steps; improves utility company revenue and provides better service for utility customers.

By **ROBERT P. THOMPSON**
Manager of Engineering, Transformers
Line Material Industries

The new L-M Self-Regulating distribution Transformer should make an outstanding contribution to profitable, economical utility operation. By providing regulation *at the point of use*, the SRT improves revenue by avoiding loss in billings caused by *undervoltage;* and it gives customers better service by more efficient operation of lights, appliances, and all other electrical devices. By preventing *overvoltage*, it reduces burnouts of lamps and television tubes.

L-M Round-Wound Design

The SRT is basically a Round-Wound® transformer with extra taps on the *primary*, and an under-load tap changer. The voltage regulating mechanism is volt-sensitive on the *secondary*, so voltage is maintained within a 3½-volt band width centered around 120 volts.

"Adapt-A-Tap" Range Selector

The "Adapt-A-Tap" range selector provides a full 20% range within which the taps for the 10% automatic regulation may be selected—all below, straddle, or all above normal. Thus the SRT may be located anywhere on the line—at the end, in the middle, or near the substation. Four 2½% steps are provided. Operation occurs only after a time delay to prevent undesirable operation and "hunting" on switching surges and momentary voltage changes outside the band width.

More Economical Regulation

The SRT provides extremely economical regulation, *at the point of use*, and it opens wider horizons to the distribution system design engineer for more effective system planning.

Sold For Test Program

The limited initial production of SRT's will be sold to utility companies who wish to make thorough tests of the possibilities of this revolutionary new engineering development. These tests should enable utilities to determine the extent to which SRT's may be applied, and the best methods of application.

Ask The L-M Field Engineer

For details about the SRT, ask the L-M Field Engineer who calls on your company; or write A. R. Waehner, Director of Transformer Sales, Line Material Industries, Milwaukee 1.

LINE MATERIAL Industries
McGRAW-EDISON COMPANY
Distribution Transformers

McGRAW EDISON

Editorial Comment

JULY 7, 1958

Are Transmission Lines Obtrusive?

There were signs of growing concern at CIGRE, the International Conference on Large Electric Systems that met in Paris last month, that overhead transmission lines may be "obtruding too greatly on the society they serve."

It was F. J. Lane, internationally known consulting engineer and former head of the British transmission network, who spelled out his own misgivings that in many parts of the world, particularly near big cities, transmission lines are occupying more of the countryside than this particular public service has a right to expect. And he expressed himself as appalled at the appearance of several sites where as many as 20 overhead lines converged on a single substation. Engineers, he said, should not presume too far on the essential nature of the service they provide.

It would be easy for American transmission engineers to be complacent with Lane's warning were it not for the fact that already in the United States the limited space now available for lines in settled communities is decreasing rapidly.

With the problem fast descending upon us, Lane's suggested solution has a particular meaning. He believes that it remains one of the engineer's responsibilities to do his utmost to minimize the obtrusiveness of overhead transmission lines by giving proper regard to appearance of structures and making maximum use of routes least objectionable to the countryside.

Let's Give "Group Dynamics" a Chance!

We watched in delighted amazement the application of the "group dynamics" technique to the discussion of three conference-type engineering papers at a technical session of the recent Summer General Meeting of the American Institute of Electrical Engineers.

It was an inspired idea and produced inspiring results. In a matter of minutes a formal group of sixty-odd professional people were transformed into six or eight animated "buzz sessions" bent on boring into the findings of a particular paper for needed clarification.

Under its impact discussion at this session "caught fire" and blazed. As we look back on the performance, the reasons were pretty obvious:

- Areas of common interest and concern were quickly uncovered
- Collective intelligence of the audience was effectively focused
- Interchange of opinion and observation was fostered by the small groups
- Men who would have remained silent offered valuable ideas
- Unnecessary formality was eliminated and a stimulating environment created

Certainly it is not our intent to suggest that the group-dynamics type of discussion will fit all the circumstances of the presentation of professional technical papers. But it offers a worthwhile change of pace and when used as a tool within the limits of common sense it offers a stimulating departure from the usual pattern of professional comment.

It should be used more often!

Democrat A-Bill May Pass

House could approve $386-million atomic construction program this week; but industry favors Ike's proposal

A Democratic-backed, $386-million atomic construction program comes up for debate in the House this week or next. Chances are the bill will pass substantially as is.

The measure, cleared ten days ago by the Joint Committee on Atomic Energy, authorizes appropriations for acquisition and construction of facilities by the Atomic Energy Commission. Actual funds would have to be voted later this session in an appropriation bill.

The Eisenhower Administration's own program sought to hold the line against Democratic demands that the federal government jump with both feet into the business of building atomic power reactors.

It called for $193-million in new atomic reactor development work, including some $20-million for new projects in the cooperative power reactor demonstration program, and $51-million for a 40,000-kw(e), gas-cooled reactor if private industry fails to come forward.

The Democratic-run joint committee, after some hesitation, approved the $20-million request. It agreed to a six-month extension (to June 30, 1959) of the deadline for initiation of new projects. And it's ready to give AEC authority to waive heavy water-use charges whether natural or enriched fuel is involved.

But the Democrats went much further. They inserted provision for more than a dozen research projects backed by the AEC itself but opposed by the Budget Bureau.

Of more interest to the power industry, the bill:

- Authorizes federal construction of a plutonium producing reactor at AEC's Hanford, Wash., works which could later be hooked up for generation of 300,000 kw.
- Allows East Central-West Florida groups' cooperative project and research on a project of Westinghouse and Pennsylvania P&L to go ahead with funds already appropriated.
- Requires AEC to build the 40,000-kw(e) gas-cooled reactor costing $51-million unless private industry comes forward with an acceptable offer under the cooperative program within 90 days after passage of the bill.

Both the joint committee and AEC are frankly skeptical that industry is ready to do the job. Government construction would mark a major defeat for the private power industry. As the first large reactor built for federal ownership, it could set a dangerous precedent in the view of the industry.

The bill does contain a clause allowing AEC to obtain participation of "private, cooperative or public power organizations" if consistent with commission direction of the project and ownership of the reactor. In light of reports that this reactor will be built at Oak Ridge, Tenn., it is felt this may open the way for participation by the Tennessee Valley Authority.

- By next spring, AEC shall complete design and engineering studies for a heavy water moderated power reactor, two large power reactors and one prototype of intermediate size, and an advanced-design power reactor capable of using nuclear superheat.

The joint committee will press for AEC construction of the heavy water reactor as soon as possible after the design study is completed. But it appears private industry will get a shot at the reactor with a nuclear superheater.

An attempt will be made on the House floor to eliminate at least some design studies from the bill. As one industry source puts it:

"Last year Congress voted design studies for the plutonium producer and the gas-cooled reactor. Now the taxpayers are being asked for almost $200-million to build them. If these five design studies are made, it appears that Congress may be faced next year with a request for federal construction of those reactors."

- Contains language making rule changes in the demonstration power reactor program, which utility industry spokesmen fear, may "reverse the whole philosophy of the cooperative development program."

The bill provides that "hereafter, before the commission enters into any arrangement, the basis of which has not been previously submitted to the joint committee which involves appropriations authorized (for cooperative projects), it shall make public announcement of each reactor project it considers technically desirable for construction..."

This grows out of a Democratic conviction that AEC has failed to exercise its leadership—that the commission should decide which type reactors should be tried next, then give industry a chance to come in more or less on federal terms.

If the new language is enacted into law, AEC will invite competing proposals on promising concepts. A company or group of companies still could come in with a new idea, but other firms would get an even break at submitting proposals for cooperative development.

"What incentive would that give private industry to spend its own money on research?" asks an industry source. "If this thing goes through, you won't see formation of any more West Florida or East Central groups."

The Administration is known to oppose every change made in the bill by the Democrats. And, with critical letters beginning to come in from coal and railroad interests, House Republicans will make something of a fight.

Despite misgivings, most industry sources concede the prospects of materially altering the Democratic program on the floor of the House or Senate are slim.

In the first place, with AEC chairman Lewis Strauss gone and his successor not even sworn in, there will be no effective rallying point within the Administration against the Democrats.

Secondly, since the departure last year of Rep Sterling Cole (R-N. Y.), there is no strong Republican voice in Congress on atomic matters. Few Republicans have even shown up for hearings this year, and those who have are mostly junior members.

Whether or not the Democratic steamroller can be slowed this year, a controversy of far-reaching consequence is shaping up for 1959.

AIEE Names Hickernell President At Buffalo

Summer General Session awards honorary membership to Quarles, gives Lamme Medal to Dr Black

AIEE PRESIDENT Walter J. Barrett confers at Buffalo with President-Elect L. F. Hickernell and General Meeting Chairman D. J. Munhall as session opens

The city of Buffalo, birthplace of hydro-electric power more than a half century ago, was host to some 1,600 electrical engineers who attended the Summer General Meeting of the American Institute of Electrical Engineers June 22-27. Highlights of sessions were these:

- Conferring honorary membership on Deputy Defense Secretary Donald A. Quarles, former AIEE president.
- Presentation of Lamme Medal to Dr Harold S. Black of Bell Labs.
- Commemoration of first commercial installation of an alternating current system in 1886 in a Buffalo department store.
- A progress report on proposed United Engineering Center Building.

Election of L. F. Hickernell as 1958-59 president of AIEE was announced at the opening session of the Buffalo meeting.

Hickernell is vice-president-engineering for Anaconda Wire & Cable Co, and is now completing a term as AIEE treasurer. He has been associated with Anaconda since 1931 following work with Iowa Light Heat & Power Co, General Electric, Consumers Power Co, Stevens & Wood Inc and Allied Engineers, Inc.

In his report to the institute membership, Pres Walter J. Barrett said he hoped and expected that the new United Engineering Center Building between 47 and 48 Streets in New York City will be completed in about 2½ years.

Fund raising for the new building is proceeding actively with Dr Marvin J. Kelly, president of Bell Labs, heading a group of industrialists who have volunteered to raise $5 million from industry. Member giving campaigns with a goal of $3 million are being organized, and a third drive directed toward commerce and industry in greater New York is under way.

Quarles Honored

At the President's Banquet, Thursday evening, AIEE conferred its highest tribute, honorary membership, upon Donald A. Quarles, Deputy Secretary of Defense and a past-president of AIEE. Secretary Quarles is the 43rd recipient of honorary membership in Institute history.

In his response, Secretary Quarles said that the U. S. is in a titanic political economic and technological cold war struggle with a nation whose well-publicized objective is world domination and the elimination of our way of life.

The 1957 Lamme Medal was presented to Dr Harold S. Black, research engineer of Bell Telephone Laboratories, at the opening meeting of the convention. Dr Black was cited for his work in inventing and developing applications of the negative feedback amplifier.

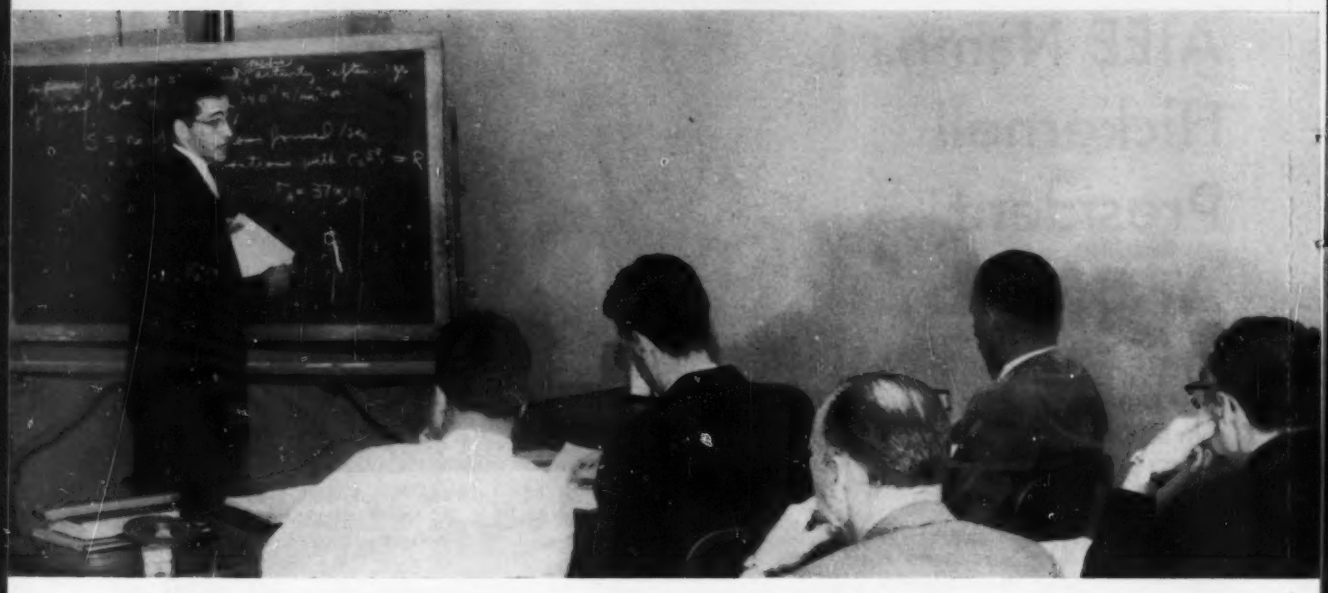
In accepting the award Dr Black emphasized the important role of a teamwork approach to fostering industrial research and invention. An individual inventor working for a large organization finds an ideal environment when he is a member of an organized team. He can consult at a moments notice with many authorities in diverse fields, and is stimulated by colleagues with similar interests.

A. C. Monteith, vice president, Westinghouse Electric Corp, was principal speaker at a special luncheon commemorating the first commercial installation in 1886 of an ac electric system in the U. S. on the premises of Adam, Meldrum & Anderson, a Buffalo retail store. This was the pioneer installation marking the first use of the ac system featuring George Westinghouse's perfected transformer.

Monteith cited the historic installation as the breakthrough which overcame distance limitations of contemporary dc systems and made possible today's area distribution. Key to this breakthrough was the transformer included in the installation which enabled low-voltage lighting to be served from a remote generator.

Newly elected directors of the Institute are: William A. Lewis, Illinois Institute of Technology; Norman F. Rode, Texas A&M College; and Eugene Starr, Bonneville Power Administration. C. H. Linder, vice president, General Electric Co, was elected treasurer, succeeding L. F. Hickernell, president-elect.

A technical report of meeting will appear in a July issue.



Atomic Theory Training Aims at

A 20-man cadre unit of highly qualified specialists is undergoing a two-year basic training course at Consolidated Edison Co of New York, Inc. The program will prepare the men for the Atomic Energy Commission tests for licensing as operators of Con Edison's 275,000-kw nuclear-fueled electric generating station at Indian Point.

The purpose of this training is not only to qualify Con Edison people for the AEC license, which is essential when Indian Point goes on the line in late 1960, but also to have a nucleus which can train the foremen and operators who will later run the atomic installation.

An intellectual "chain reaction" will spread through the Con Edison system as these men return to electrical engineering, mechanical engineering, station construction and shops, system engineering, production, and Westchester departments. Each department will have at least one man trained in the fundamentals of nuclear engineering and the operation of an atomic plant.

The program began officially early this year under the supervision of Arthur N. Anderson, assistant vice president, construction. Preliminary training was underway, however, at the utility's Waterside generating station on the Manhattan side of the East River a year ago. About half of the group is from the production department and most of these men have held staff jobs. At Waterside they were given a chance to "get their hands dirty" in handling the physical operation of a power plant. They did everything from running boilers, operating turbine controls and high boards to actually phasing a machine into the bus.

The production men required only two months of this practical training as a refresher course, but the others will get from six months to a full year of this experience.

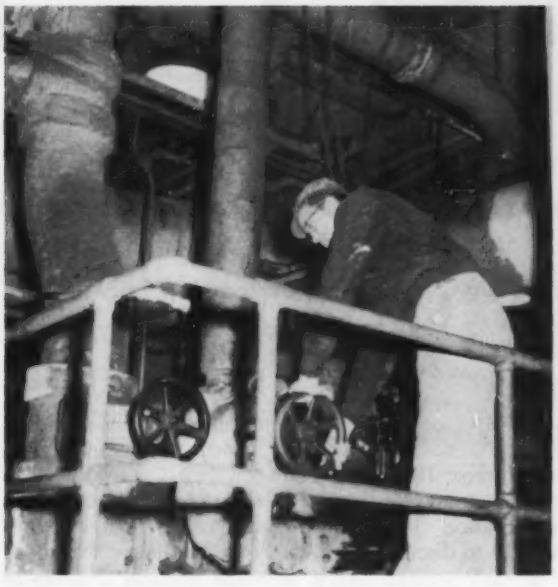
Two Text Books Used

Vitro Engineering Co is training this cadre group in fundamentals of reactor engineering, nuclear fuel handling, and in general what makes the reactor tick. Anderson emphasizes that "no one expects these men to be able to design a reactor themselves," but that "they should know the fundamental atomic theory." The Vitro course is at Con Edison's main building in Manhattan, four days a week, from 9 to 12 noon. The group is divided into two classes, each attending two classes every week.

In addition to those being trained to operate the plant, another selected group of about ten Con Ed men from various departments is taking the Vitro course. These men are concerned primarily with the plant's design.

Both the operating and design groups receive more than merely a lecture series. Homework is required. Two text books are used: *Sourcebook on Atomic Energy*, and *Principles of Nuclear Reactor Engineering*, both by Samuel Glasstone, an AEC consultant. Different phases of the course are being taught by top personnel of Vitro.

Among the topics that will be learned by the trainees are: the design of a nuclear power plant, basic atomic and nuclear theory, radioactivity, nuclear reactions, health physics, waste treatment and purification, utilization of nuclear energy, reactor dynamics and control, and nuclear reactor instrumentation. Although such things as neutron flux and radioactivity levels seem in the realm of science fiction, education tends to dispel their esoteric quality and brings atomic fission into focus as just a



'Chain Reaction' Spread of Know-How

new and very complex form of heat.

The classroom course in nuclear engineering began in April and will be completed in 48 sessions by the end of the year with a two-month break in the summer. In addition to the regular course, some of the students have met informally each month to discuss current developments on Indian Point and nuclear technology in general.

Sometime next year, a few students (those involved with initial operation of Indian Point) at a time will be given on-the-job training at various U. S. atomic installations such as Shippingport to assure their meeting AEC licensing requirements and to learn how to actually operate an atomic plant. Simultaneously, men from the various departments will take the conventional plant operation phase of the program. In addition, some of the production men will receive training in other departments to give them a background in construction and engineering. For example, two production men are currently assigned to the nuclear engineering division of the mechanical engineering department.

Later, the trainees will be given instruction by manufacturers' representatives and others on the specific equipment to be used in the nuclear generating station. The trainees will be involved with writing and preparing all operating procedures for Indian Point. They will participate in testing the nuclear equipment and the entire plant system prior to the scheduled operating date in late 1960. This is the group that will start up and supervise the initial operation of the plant.

Younger Men Chosen

The trainees will remain at Indian Point until all the "bugs" have been worked out and the regular operators have been trained by them. They will then return to the various departments. Of the approximately 100 men who will be working at Indian Point, only about 15 will require AEC licenses. This group will be made up of operators and foremen.

The trainees were told not to volunteer for the project unless they really wanted to be a part of the Indian Point development. Most of them are in their late 20's or early 30's. Younger men were deliberately chosen because of the project's long-term aspects. They had to pass rigid physical tests to meet AEC requirements. All of them have degrees in science or engineering.

In order to facilitate discussions on atomic energy before these men are actually licensed, "Q" clearances (top secret) were obtained for the initial group. So much material in this field has been declassified since the program began that it wasn't necessary to obtain clearances for those taking the course later, and the class is conducted on an unclassified basis.

In addition to meeting physical requirements, each applicant must pass an operating test, written examination, and show he has learned to operate the controls competently and safely. The license is limited to the specific facility applied for and must be renewed every two years. Periodic physical examinations are required.

For the most part, Con Edison looks at Indian Point as just another generating station and atomic energy as just another source of fuel. But understandably, the excitement of being in on the ground floor of atomic energy has communicated itself to the men taking the program.

CIGRE Meets in Paris—Focuses on

USA's SPORN: The doubling load is the driving force behind EHV

USA's MEADOR & WAGNER: EHV means transformer, corona advances

USSR's LEBEDEV: USSR leads the world in use of higher transmission voltage

- **'Freedom of exchange' atmosphere permeates technical discussions. Russians appear able to say what they please**
- **Trends in power generation and energy demands have not diminished need for long-distance, high-power transmission**
- **High voltage dc transmission is now coming into its own technically and economically to be considered in any project**

J. H. M. SYKES, Bedford, England

CIGRE 1958, the 17th meeting of the International Conference on Large Electric Systems, drew 1800 power system engineers from 50 countries to Paris, France, last month from June 4 to 14 to discuss technical progress in high voltage transmission and generation.

Discussions centered around more than 130 papers by engineers from 25 countries; eight by U.S. authors.

Three major trends marked the meeting:

• **First,** for the first time there was complete freedom of exchange, on the technical level, between East and West and among all the countries attending the Conference. Russian engineers, in particular, were able and willing to meet delegates from the United States, Great Britain and elsewhere alone or together, and it was obvious that they spoke with complete freedom.

• **Second,** the various trends in power generation and in the demand for energy have not diminished the need for long distance, high-power transmission: Great Britain with its advanced nuclear program showed that the need for transmission would become even greater. Other countries, where the harnessing of more remote sources of power is increasing, showed that extra-high voltage transmission over increasing distances has no foreseeable limit. However, there was a salutary check to the bounding enthusiasm of some engineers in the speech by a British expert, who said that overhead lines in many cases were occupying more of the countryside than this public service had a right to expect.

• **Third,** the use of high voltage direct current for power transmission is now accepted as having its proper place, and as being sufficiently well proved to be considered on its technical and economic merits for any particular transmission project.

Registrations for this year's conference was greater than ever before, and reached almost two thousand, although political troubles in France prior to the Conference meant that a number of delegates did not attend.

The section on developments at extra-high voltage under the chairmanship of Philip Sporn, president, American Electric Power Service Corp. produced significant discussion in a number of areas.

In opening the session Sporn observed that in most countries load doubles in ten years. This he said, is the driving force behind extra-high voltage development.

Although Sporn thought that the seeds of saturation might possibly be there somewhere, he said they are very far off. Extra-high voltage development is not now the exclusive prerogative of a few countries. Its technology is expanding.

F. Cahen, of France, said the questions in EHV development that appear to be of the greatest interest can be divided into three groups: Utilization of extra-high voltages; internal overvoltages; and corona and radio interference.

F. J. Lane, of Great Britain, formerly in charge of transmission for the Central Electricty Generating Board and now a consulting engineer, warned that engineers should not presume too far on the essential nature of the service they provide. In many parts of the world, particularly near big cities, overhead lines are already obtruding too greatly on society. He mentioned several sites where 20 lines converged on a substation.

"The economic incentive to use

RAPT ATTENTION is written on the faces of conferees attending the International Conference on Large Electric Systems (CIGRE) in Paris, June 4-14

the overhead line as much as possible is . . . understood by the public as well as by the engineer. At 275 kv the ratio of the cost of undergrounding to the cost of a double circuit 550 MVA overhead line may be of the order of 16 to 1," continued Lane. "It still remains the engineer's responsibilities, he said, to minimize the obtrusiveness of overhead lines by restricting overvoltages, to reducing tower sizes; giving proper regard for appearance of structures; making maximum use of any line route with the minimum interference with the countryside."

Lane emphasized the need for continued research on underground cable insulation, so that by the use perhaps of direct current with plastic-insulated cables the transmission cost might be comparable with overhead lines costs.

Sporn intervened to concur generally with Lane and to point out that the very limited space in settled communities for transmission lines is decreasing rapidly. Accordingly in the U. S., compulsory right of way acquisition should be used with the greatest discretion, he said.

"Many people think transmission towers are inevitably ugly," Sporn said. "Engineers should look at the Eiffel Tower to see that a steel structure need not be a blot on the countryside."

The chief Russian delegate, Boris Lebedev, showed that the U.S.S.R. leads the world, at the moment, in the use of the higher transmission voltage. Lines in that country are working at 420 kv and the Russians have made the discovery that it is feasible to change to 500 kv by using the same towers and substation structures generally, radically changing only the autotransformers. Thus, they achieve 40% more power transmission. In fact, their 400-kv system, now under construction, is to be changed over to 500 kv. The first such line is now under construction as part of the high voltage grid in Western Russia.

Lebedev said that in Asiatic parts of the U.S.S.R. transmission problems involve carrying 2,000 Mw some 2,000 kilometers. Here, the economics of alternative methods of carrying energy have been considered. In some cases pipelines are being examined as an alternative to electrical transmission where oil and coal are involved. Future development of the system at 600 kv or 700 kv, or 800 kv d.c., with a possible extension to 1,000 kv d.c. is being studied.

Speakers from Britain and Sweden showed that nuclear generation would not be likely to decrease the need for transmission. During the early days of nuclear development in Britain, location of plants far from centers of population inevitably meant additional transmission capacity. In Sweden presence of hydro-electric resources in the extreme north and the fact that these stations form ideal partners for nuclear plants, led towards the same conclusion.

Conversions Described

As the session turned to consideration of the increase of voltage on existing transmission systems interest focused on a report from France showing how a 287-mile, 225-kv, Alps-to-Paris line embodying two separate single-conductor circuits built ten years ago, was converted to a single circuit 380-kv line with twin-bundle conductors.

J. W. Simpson and V. E. Ogorodnikov of the Hydro-Electric Power Commission of Ontario, described the conversion of 115 kv lines to operate first at 230 kv and later at up to 262 kv.

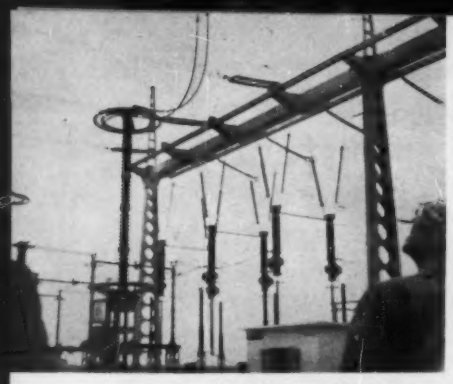
British delegate Casson of the Central Electricity Generating Board explained that the choice of 275 kv as the best voltage in the British grid allows a double circuit 132 kv line to be converted to a single circuit 275 kv line of double the transmission capability. A similar conversion of 275 kv to 380 kv would only increase the capability by 50%. He felt it would be better in all cases to reinforce by building a new line unless it was possible to at least double the amount of power carried across a given route.

Dealing further with the question of improving the capacity of overhead lines, Dr. Burgsdorf of the U.S.S.R., said research had shown that insulation levels of the 400 kv system could be arranged on the basis that overvoltages would be 2.5 rather than 3 time the phase voltage as formerly assumed.

On the question of corona and radio interference problems, the U.S.A.'s announcement that tests were to be carried out on lines operating up to 750 kv excited considerable interest.

The most common method of countering radio interference is the use of bundle conductors, and two American contributions in this field were of special interest. W. S. Price, of U.S.A. said it will still be one of the most complex problems transmission engineers had to face.

A. R. Hard of the Washington State Institute of Technology reported the results of studies of conductor vibration on an outdoor span under an actual transmission line on the Bonneville power system. His paper provided a useful survey of every existing type of spacer.



SUSPENDED CIRCUIT BREAKERS are observed by CIGRE conferees. Located at substation in Plessis-Gassot in France, they are minimum-BIL type rated 380 kv

between the 20 or 30 spacer types now evolved in Russia, the Western European countries and the U.S.A.

Russian engineers acknowledged the desirability of limiting radio interference and have evolved the three-conductor bundle mainly for this purpose. However they felt basically that it was not so important as the corona losses which above 500 kv might well affect the economic working of the line. In the special report, however, Cahen of France said that the general view was that radio interference problems were more important than those affecting corona losses.

The German engineers reported that the 4-bundle lines they had adopted for 380 kv had given extremely low radio interference levels. The British reports concerning twin-bundle 275 kv lines showed that the interference level was generally acceptable even when the line passed within a few hundred yards of residences.

Detailed discussions in the sections devoted to generators, transformers, circuit breakers and cables produced less new material this year than in most other CIGRE years. Nevertheless, some points of special interest emerged from the papers and discussions. In the transformer field, a paper by A. Lang of A.E.G. (Germany) advocated a d.c. controlled reactor as a transductor for high voltage power transformer tap-changer application. The advantage was elimination of contacts. Cost would be considerably in excess of the normal types of tap-changer however.

An American contribution on transformer noise, by E. C. Wentz of Westinghouse, was read with particular attention by British engineers who found that noise problems in residential areas had given them a good deal of trouble.

There was a reaction against proposals that very large transformers be given overvoltage tests on site after erection, and that impulse tests should also take place on site. This was considered not only unnecessary but very costly.

The substation section suffered a little from lack of a common theme. Some papers dealt with widely divergent aspects of substation construction. For the first time at CIGRE Conference, there were papers from the People's Republic of China. They dealt with the prefabrication of concrete structures for high-voltage substations in which a minimum of steel was required.

Cable Views Differ

The cable session was notable for the general acceptance of the need for direct-current cables for submarine use. Perhaps the most interesting of d.c. schemes reported was a proposal from Italy for a cable 82 miles long crossing the Adriatic Sea and linking the Yugoslav water power resources with the areas in the south of Italy where there is a power shortage. This scheme is generally approved by both Yugoslav and Italian technicians. It awaits only the agreement of the Yugoslav Government before practical plans can be prepared.

There is still room for argument as to the best form of submarine cable, whether for a.c. or d.c. use. For d.c., the choice so far has fallen on a paper impregnated cable of the solid type. A valuable paper by Mr. Gorodetzki, of the U.S.S.R., gave full details of service experience with a ±200 kv cable, and in both cases comparisons were made between solid and oil-filled types. A British paper by Mildner and Humphries, advocated the use of plastic-insulated cables for high voltage d.c. The authors stated that extruded plastic cables working at 200 kv to ground have been proved practicable.

A Japanese contribution indicated the use of a submarine plough to cut a channel below the surface of the sea bottom.

The most controversial point emerging from the cable session was the question as to whether continuous manufacture of the cable, in one length, is such an outstanding advantage as some British manufacturers claimed.

Technical Papers By U. S. Authors at CIGRE

1. "Radio Interference As It Affects Transmission Line Design," By G. E. Adams—General Electric Co.

2. "Experience With Ultra-High-Speed Reclosing Circuit Breakers During the Last 23 Years on the American Electric Power Corp System" By J. H. Kinghorn, H. C. Barnes and A. Hauspurg, American Electric Power Corp.

3. "High Altitude Corona and Radio Interference Measuring Installation at Leadville, Col." By L. M. Robertson—Colorado Public Service Co. and C. F. Wagner—Westinghouse Electric Corp.

4. "Special Problems and Trends in Large High Voltage Transformers" By E. C. Wentz—Westinghouse Electric Corp.

5. "Switching Surges and Arrester Performance on High Voltage Systems" By I. B. Johnson—General Electric Co.

6. "Studies of Conductor Vibration in Laboratory Span, Outdoor Test Span, and Actual Transmission Lines" By A. R. Hard—State College of Washington

7. "Insulation Aspects of Large High Voltage Transformers" By J. R Meador—General Electric Co.

8. "The Application of Digital Computers in Power Systems Analysis in the U.S.A. By W. F. Tinney and R. J. Brown—Bonneville Power Administration

34.5-Kv Stub Feeder Goes to 69 Kv

Conversion by linemen involves hot-stick techniques; special clamp proves helpful

M. J. DOODY, Distribution Supervisor, Atlantic City Electric Co, Atlantic City, N. J.

The Atlantic City Electric Co crews faced the problem of converting a 34.5-kv pin-type stub feeder to 69-kv suspension-type line. It was necessary to perform this work "hot" so that this line could be tied into an eventual 69-kv loop. Normal growth and expansion made this voltage improvement necessary.

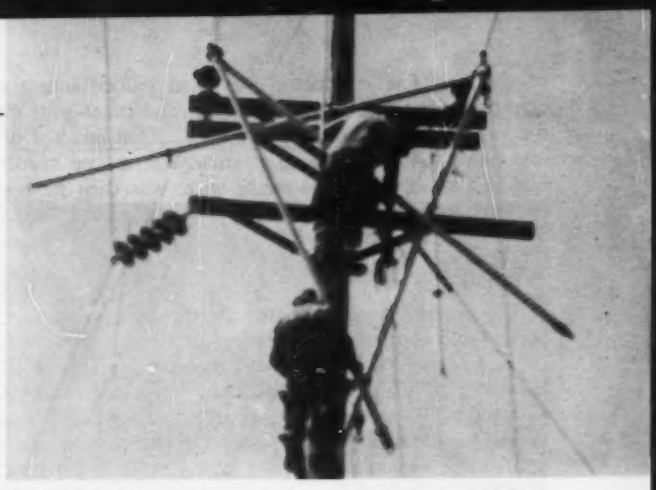
The problem was solved effectively at a cost of about $6,000 per mile, an average of five poles per day being completed on straight-line construction. In doing it, the crews found their most valuable ally to be a single-bolt, J-type suspension clamp with a side opening, which was used in lieu of the conventional suspension clamp composed of two U-bolts and a keeper. The linemen liked matching their ability against this new problem and brought to the task their considerable experience with hot sticks on the company's large 12-kv, grounded-wye distribution system.

The converted line extends 12 miles, from Laurel Substation in Bridgeton to Newport Substation, near Newport, all in New Jersey. More than half of its right-of-way is through swampy and wooded areas, and the rest is accessible by means of some sort of roads or wood paths.

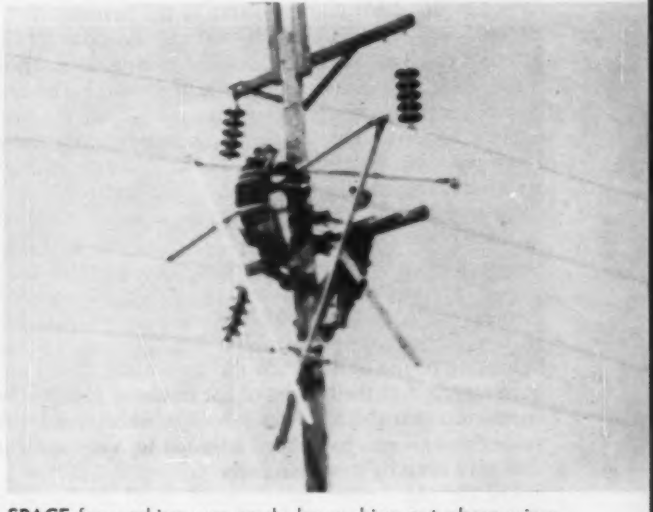
The 34.5-kv line construction consisted of pin-type insulators mounted on two arms, 4½ ft between gains, with a static wire mounted 4 ft 3 in. above the top arm. The 69-kv construction was to consist of insulator strings having five, 10-in. disc insulators suspended from arms, 6 ft between gains, with a static wire 4 ft 3 in. above the top arm. To minimize replacing the 45-ft poles, a wood bayonet was added to the pole top to support the static wire. It was necessary, however, to replace angle and corner poles to provide additional height for vertical construction.

After trying several, the method that seemed to work best involved cutting the bottom gain first. This was nearly 3 ft below the original top gain. When the bottom gain has been cut, one phase on the old arm was untied and held clear by sticks and saddles. The old arm was then removed and lowered to the ground.

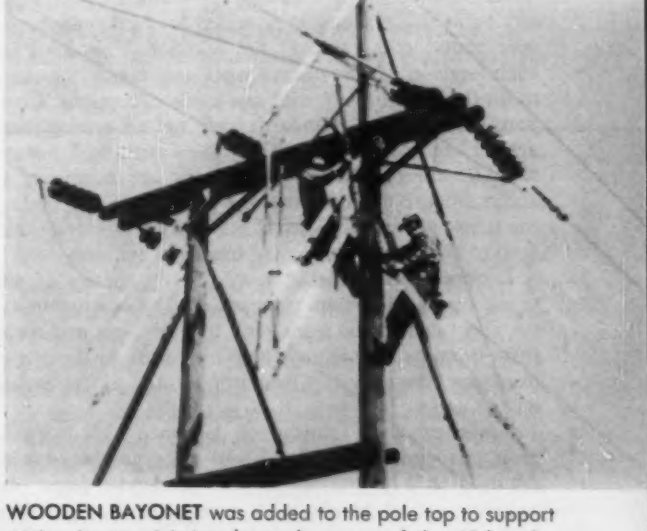
The new 4x5-in. x 9-ft arm was mounted in the new gain, and a string of insulators was hung in place, the suspension clamp being open on the side to admit the



CONVERSION of 34.5-kv pin-type stub feeder to 69-kv suspension-type line necessitated much hot-stick line work



SPACE for working was made by pushing out phase wires from the pole with hot sticks which were then made fast



WOODEN BAYONET was added to the pole top to support static wire to minimize the replacement of the 45-ft poles

conductor. The conductor was then guided into the clamp, the insulators were lined up, and the J-bolts on the suspension clamp were tightened. That finished off one phase. A small-diameter stick, left in one saddle and still attached to the phase wire, was then pushed outward from the pole as far as it would go and locked there to give maximum clearance.

Top-Arm Conductors Changed

The next step was changing the top-arm conductors. When both remaining phases has been untied and suspended on hot sticks as far as necessary from the pole, the old arm was removed. The new top gain was cut some 9 in. from the pole top. A 13/16-in. hole was drilled for the new gain and, about 18 in. lower, another hole, 11/16-in. in the same direction through the pole. The bolt in the top gain, besides securing the new arm, was long enough to take the new 4-ft 6-in. bayonet in the top hole, and another bolt to secure the bayonet in the bottom hole. By hand, the static wire was then attached by an approved type clamp to the bayonet.

Some old-type suspension clamps were used for hanging the new arm and installing insulators, until the simpler, side-entrance clamp came along. The old clamp, consisting of a body, U-bolts, and a pressure bar, is installed separately. Its clevis pin removed, the body is slipped over the conductor. Then, by means of hot-stick attachments, the clevis pin is replaced to secure the clamp body to the clevis so that clamp cannot fall to the ground.

The clamp rests upside down on the conductor. U-bolts are inserted from the top, and the nuts started just enough to hold the bolts in place. The pressure bar is then slipped into position and held there by further tightening of the nuts. When the suspension clamp has been attached to the bottom of the insulator strings, the conductors hang free. The job is finished, once the suspension clamps have been adjusted to hang straight and have been tightened securely.

On the older construction, some small angles were simply double arms, pins, and pin-type insulators taking up additional side strains. The conductors were tied in securely on the double insulators.

As conductors were already positioned about right, any extra side strain was provided for by having heavy wire tongs, etc., take up the additional burden. On such angle construction the work was much the same as on the straight way with just a few exceptions. Company construction standards call for off-setting both arms 12 in. toward the strain. Gains must be 7 instead of 6 ft. apart. These specifications are necessary to accommodate a 12-in. triangle bracket in the end of the arms toward the strain. Conductors on that end tend to swing in too near the braces of the arm.

Dropping the conductor 12 in. by means of the bracket maintains ample clearance. The conductors on the short end of the arms tend to swing out and away from the pole. Attaching these insulators to the angle-iron brackets puts the insulator strings a few inches off the end of the arm.

Some very long spans were deadened back-to-back, most deadends being five 10-in. discs combined with the usual 2/0 to 4/0 copper wire deadend clamps. An ordinary set of blocks with wire grips was installed on the line and enough strain taken to tighten them. The U-bolts on the deadend clamps were loosened, more strain was taken on the blocks, and then the deadend clamp was removed from the string of insulators and the line.

When the new clamp was fitted to the line at a measurement previously decided on, the clamp was tightened securely in its place. As the string of insulators hung down straight, it was easy to attach an extra 10-in. disc to it. The string thus placed in the line, full tension was transferred from the blocks to the deadend.

In the use of this method, the strain (tension and sag) is very nearly what it was previously. Most jumpers from deadend to deadend were continuous, not having lengthened enough for adjustment.

Some deadends are vertical. On most of these, the vertical spacing between conductors was ample for 69-kv operation, and only an extra disc was added to each deadend string. Such work, beginning with the bottom conductor, progressed upward. The blocks were applied, and the deadend clamp shifted outward to make room for the additional 10-in. disc.

Part of the line traveled double circuit with a 69-kv circuit on the opposite side of the pole. The energized 69-kv circuit was simply held off in the insulator strings as far as practicable to increase clearance. Then, with the necessary stick and saddles, the job was accomplished by adding a 10-in. disc to those in use.

Tied into Transformer Bank

This section of the line had also several back-to-back deadends, each requiring an additional 10-in. disc. At each of these, when the strain had been taken up by the blocks, the insulator string was disconnected and the disc added. The deadend clamp, previously loosened under semi-strain by means of the blocks, was pushed out to its new location. It was tightened, and the string was attached. When the full strain had again been transferred to the deadend, the clamp was fully tightened, and all hardware was checked for proper installation.

Some work could not be done properly while the line was hot. At several places, the old line crossed from one side of the road to the other by means of back-to-back deadends on double arms, by merely taking the angle on double arms, or by both. In the old flat construction, no additional height of poles was needed for deadends or pull-off (angle) poles.

In most cases, the new 69-kv construction calls for poles of at least 60 ft for pull-offs or deadends. Accordingly, conductors had to be transferred vertically to their new position on the new poles. Although this transfer could probably have been accomplished while the line was energized, it was considered expedient to do otherwise. The company selected an off-peak day, a Sunday, when the Newport Sub-station could be tied to an adjacent 12-kv sub-station for operation at satisfactory voltage levels. The crews then cut, transferred, and pulled slack in the conductors, all in one day.

On a second Sunday, the newly converted line was attached permanently to a new bay with OCB's at the source, Laurel Street Sub-station. At Newport, the new line was also attached to a new 69-kv section and tied in electrically to the new 69/12-kv transformer bank.

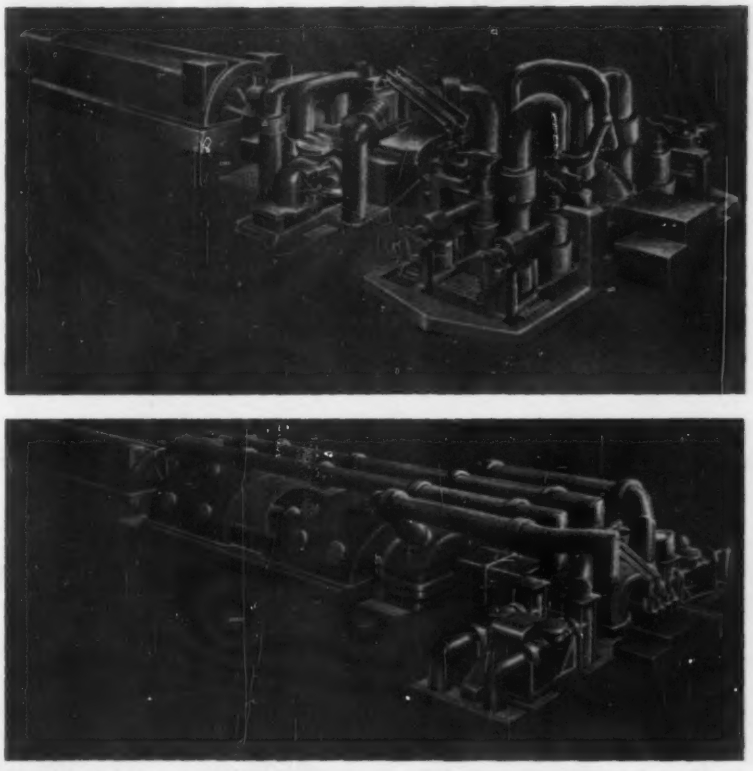
The line was then energized at 69 kv phased in at Newport, and the transformer bank was energized.

Eliminate Housings On Large Turbines

G. E. KLAPPER, Staff Engineer, Mechanical Engineering Dept, Philadelphia Electric Co, Philadelphia, Pa.

Both supercritical units at Eddystone Station of Philadelphia Electric Co will go into operation minus the conventional sheet metal lagging structures on both the high-pressure and low-pressure shafts. This simplification was judged worthwhile after several factors of immediate and future concern were evaluated.

At the offset, considerable savings in initial capital costs are possible, even though a better than normal finish will be required on the turbine casing and steam piping insulation. The finish will consist of block or plastic insulation given a smooth trowelled finish with asbestos cloth pasted and stapled, and with a final coat of PVC paint. Cost of this better finish will about balance the estimated cost of maintaining a good appearance of the sheet metal structures through the life of the units. Although the appearance of the turbines minus the housing is a matter of personal preference, the functional look of the uncovered units should satisfy most of the engineering and operating personnel.



FUNCTION OF COMPONENTS on high pressure (upper) and low-pressure (lower) shafts is apparent when sheet-metal lagging structures are eliminated

Elimination of the lagging structures should promote better housekeeping. Large areas under them can accumulate dirt and debris, which more than likely will be removed if visible. With no structure to interfere, it should be easier to combat any fire which might occur in the vicinity of the turbine-generator.

Absence of massive structures will be an asset during unit overhauls. There will be no need for large floor areas on which to store the housings. Considerable time will be saved, particularly during any forced outage, because the turbines can be opened-up more quickly.

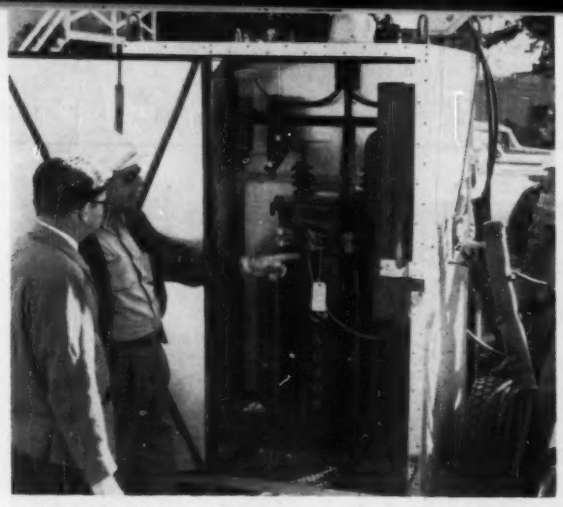
Old Transformer Becomes Modern Sub

J. E. HOOPES, Substation Engineer, Kansas City Power & Light Co, Kansas City, Missouri

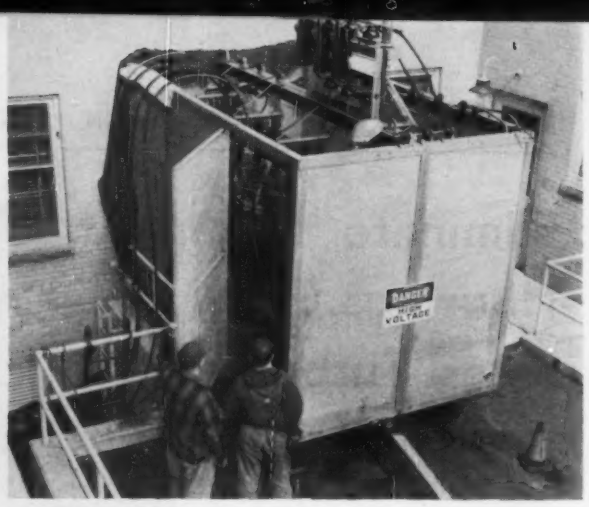
Surplus network transformers are used by Kansas City Power & Light Co to give a neat appearance when providing underground service in residential areas. The low-cost outdoor transformer now used blends with the modern lines of the buildings. The totally-enclosed design was developed by the company for a 225-kva, 120/208-v load at a country club.

A surplus 300-kva network transformer was installed on a pad. A metal box, bolted to the transformer in place of the protector, houses metering transformers and secondary underground terminations. Conduit and metal housing on the primary side protect the 15-kv paper and lead cable. The installation was painted a light green to blend with the building exterior.

The terminal pole, with arresters and fuses, is 900 ft from the transformer. The transformer is fed by a 1/0, 3/c, 15-kv PILC cable with galvanized steel tape and jute outer covering. The cable is direct buried at a minimum depth of 3 ft.



SINGLE-PHASE UNIT is a multi-ratio substation with a rating of 75 kva, 4,160-7,200/12,450 v wye—120/240 v



THREE-PHASE UNIT contains three 167-kva multi-ratio units and a 75-kva unit for 3-phase power connections

Lamps Supervise Water Treatment

J. W. RUFF, Chief Chemist, Muskingum River Plant

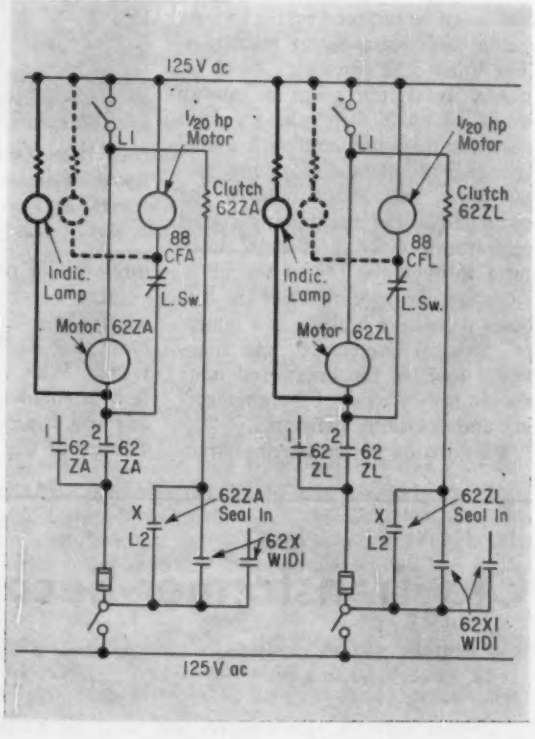
RONALD MARSHALL, Assistant Division Manager, Ohio Power Co, Beverly, Ohio

Indicating lamps for supervisory checking of chemical feeds to precipitators save time in detecting erratic operation and locating its cause, thus assuring greater uniformity in the quality of treated water. The relatively simple, inexpensive application of two supervisory lamps at Muskingum River Plant indicates operation of the 1/20-hp motors which control chemical draw-off.

These pilot lights were installed immediately above the respective timers on the water-treating control panel. Preferably, they should be connected (dashed lines in the drawing) to eliminate inclusion of the limit switch, but no spare wires were available in the existing control cable. Expense of installing the preferred circuit was not justified.

For more than one year chemical feeds to the precipitators were unsatisfactory. Cause of the trouble was found to be erratic operation of timing relays 62ZA and 62ZL, in which the contacts are closed electrically and tripped mechanically. Any delay in resetting the relays caused a similar delay in operation of the associated chemical-feed motors. These motors operate intermittently for a few seconds during a period of possibly three minutes or more, depending on water flow through the treating plant.

Now, with the indicating lamps, the filter plant operator is able quickly to detect erratic operation and arrange for correction. Also, the lamps permit easy checking of the chemical feed period for each operation of the automatic controller by observing the period that each lamp is lit during a timing relay operation.



INDICATING LAMP CIRCUIT was used because of available spare circuit in control cable. Dashed circuit would be preferable in a new plant, as it excludes limit switch. Erratic motor operation is easily checked

Small Portable Subs Help Three Ways

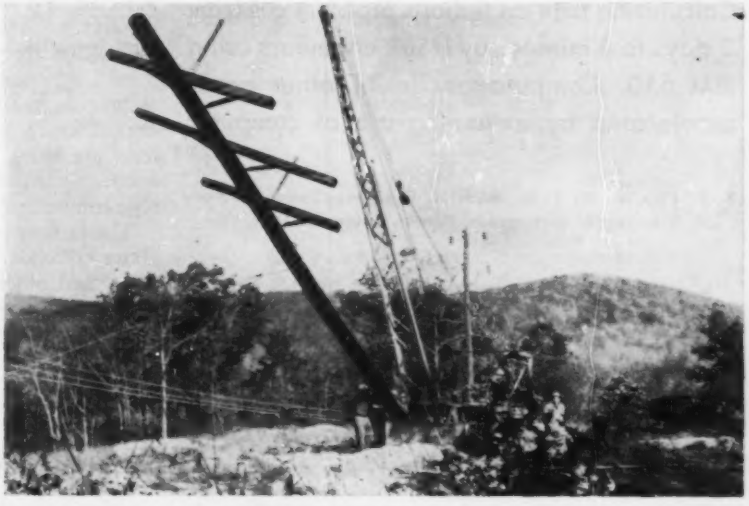
GEORGE ROBERTS, Superintendent, Transformer Department, Toledo Edison Co, Toledo, Ohio

Extensive use of portable substations by Toledo Edison Co has enabled the company to schedule much work on regular time rather than overtime, reduce outage time considerably, and contribute toward improved public relations. Three small portable units, built by company personnel, have become as indispensable as the older and larger 2,000 and 5,000-kva mobile substations.

Two multi-ratio single-phase substations are rated 75 kva 4,160-7,200/12,450 v wye—120/240 v. These are used primarily in cutting over feeders to 12,740 v. They are useful also for routine transformer changes as well as for trouble calls.

The third substation also is multi-ratio voltage. It is a 500-kva three-phase unit rated 2,400 x 7,200/12,470 v wye—120/240/480 v, thus making it adaptable to any voltage requirement. In addition to three 167-kva transformers installed in this portable, there also is a 75 kva multi-ratio transformer. This unit is the same as those in the single-phase portable substations. It is used when the bank is connected for three-phase power instead of 4-wire, 120/208 v. The third substation is used for 12-kv conversions, as well as routine and trouble calls that require greater flexibility than the single-phase subs have.

Front-Mounted Boom Speeds Pole Setting



Tripled production of pole-setting in rugged terrain has been achieved by Orange and Rockland Electric Co by using a crawler tractor with a pole-setting boom on the bulldozer blade. This modified machine also permits the setting of up to 70-ft poles with crossarms already mounted.

Much of the company's service area is mountainous. Large rock outcroppings and grades as steep as 50% previously had necessitated setting poles by hand. Before the company obtained the tractor, its crews were able to set only one 40-ft pole a day when the terrain was too rough for trucks. The trucks can set up to three poles a day, but without crossarms. With the tractor and boom, line crews can set up to three poles a day under any ground conditions.

With the boom mounted, as usual, on the rear, the tractor did not have enough weight to counterbalance the larger poles. By mounting the boom on the bulldozer blade, the company created a 28-ft stiff-legged crane.

Minor modifications included the use of 1-in. steel plate to construct a box section to support the mounting trunnions on the back top center of the blade. Heavy steel stops prevent the boom from crossing center and falling backward over the tractor. Other modifications were two brackets to carry the cable from the winch on the rear of the tractor to the boom.

Because the poles are being set in terrain too rough for trucks, the tractor also snakes poles into the area. To facilitate skidding, the front of the pole is raised by passing the winch cable through a hole in a 1x6-in. steel plate, bolted halfway up the frame. Side support for the boom is provided by one long guy wire, anchored on each side of the tractor to special pads on the bulldozer trunnion mountings.

The boom may be installed or removed in five minutes. Removal of one bolt on each side frees the boom from its trunnions. U-bolts attach the guys to the bulldozer trunnion mountings. With the boom removed, the tractor has normal use of its blade.

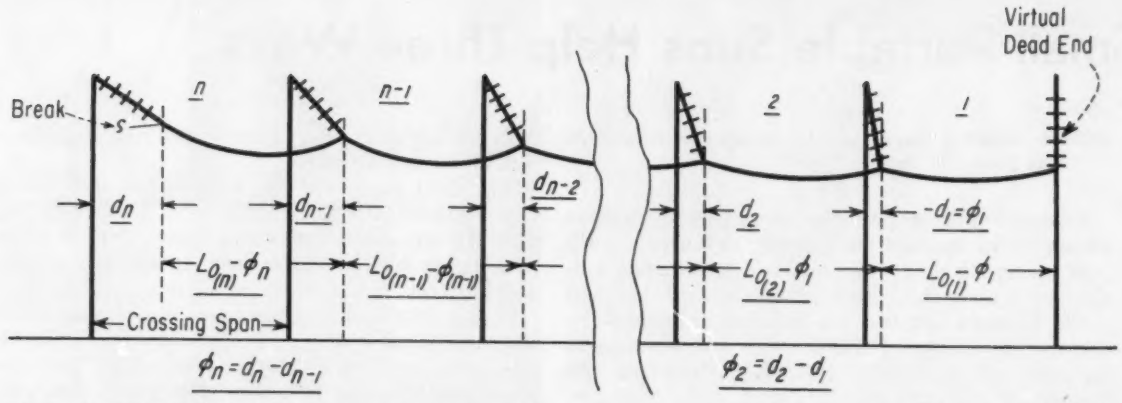


FIG 1—SUSPENSION INSULATORS swing from vertical adjacent to broken conductor span, reducing tension and increasing sag in adjacent spans. Effect lessens with distance from break to zero at deadend or after 7-8 spans

Computer Speeds Solution of

Calculation time on tedious problem cut from 3 days to 4 minutes by USBR engineers using IBM 650. Computations in 11 other areas accelerated by extending use of computer

F. E. SWAIN and **T. M. AUSTIN**, Engineers, Design Division, U. S. Bureau of Reclamation, Denver, Colorado

Use of an electronic digital computer by U.S. Bureau of Reclamation engineers has greatly accelerated the lengthy calculation of impaired crossing clearances adjacent to a suspension insulator span with a broken conductor. This is but one of the problems on which the USBR Denver office reports the high-speed computer's significant gains. In general, improved design techniques, markedly lower engineering manhours and overall lower design costs are cited. Technical problems are being solved in 1/30 to 1/300 of the time needed by a competent engineer with a standard desk-type computer.

The broken conductor impairing adjacent clearances above railroads, communication lines, structures, waterways, and other important crossings poses a problem of high interest to transmission engineers. When conductors are supported by suspension insulator strings,

Other Applications of Digital Computers

- Calculating transmission line A, B, C, D, equivalent π, and T constants in about 6 sec against more than 30 min manually for the same line length.
- Determining transmission losses from kv, kw and kvar obtained with an ac analyzer power flow study. High accuracy with minimum engineering time is noted.
- Computating and tabulating stringing sag tables for HV lines.
- Solving simultaneous linear equations in many unknowns and inverting matrices as found in many engineering fields. Comparable results often are practically unobtainable manually.
- Calculating earthwork quantities for canals and large concrete pipe trenches. Typically, computations for nearly 120 mi. of canal, representing 5 man-months of manual work, were completed in under 9 hr.
- Reducing data from concrete-embedded strainmeters to determine internal strain and stress. The volume of calculations required exceeds the capability of a moderate-sized engineering group using desk machines.
- Analyzing arch dams by trial load procedures. Many studies can be run faster with fewer engineers, and optimum designs are achieved.
- Predicting water runoff in large drainage basins using multiple correlation techniques.
- Studying hydrology system operation to find optimum water use in one or more drainage basins for irrigation, power, etc.
- Analyzing rigid frame structures to find moments, thrusts, shears, and stresses.
- Preparing data tables for many engineering uses.

Under consideration are these additional applications:

- Supplementing ac network analyzer studies of power flow and stability.
- Developing water quality control.
- Studying flood routing.

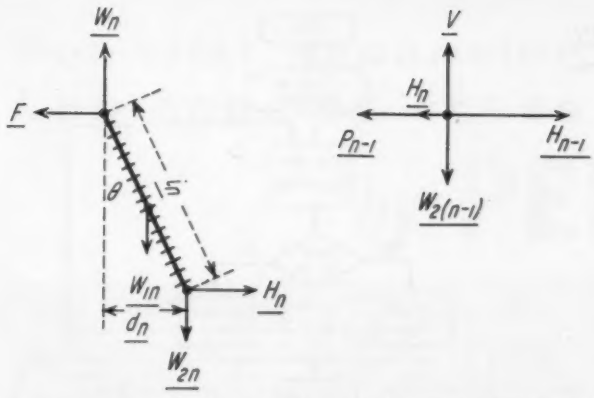


FIG 2—INSULATORS NEXT to the broken span are displaced

FIG 3—NEXT STRING feels the unbalance in span tension

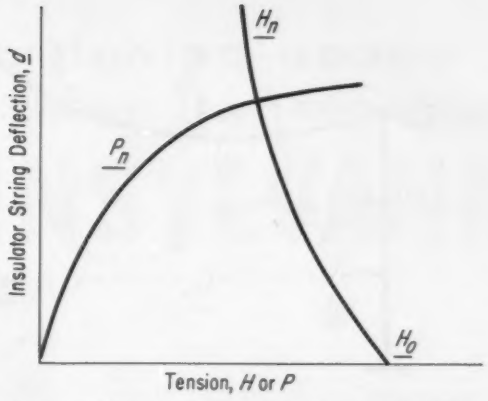


FIG 4—CROSSING OF CURVES gives the tension in span adjacent to break in the step-by-step method

Broken Conductor Crossing Clearance

a broken conductor in an adjacent span will cause the strings to swing to reduce tension, thereby increasing sag. This problem is difficult to solve, but a technique developed by G. R. Wiszneauckas, formerly of the Bureau, obtains the tension from which the increased sag can be calculated conventionally. Bureau engineers, using the Wiszneauckas method, have enlisted the IBM 650 computer to get solutions in about 4 min, versus about 3 days needed by an experienced engineer with desk calculator.

Successive insulator strings in spans receding from the broken conductor swing less and less from the vertical until, after a few spans, the swing approaches zero (Fig 1). Experience shows that little effect remains after 7 spans. When a deadend exists near the break, the effect terminates at the deadend.

Following a break, forces acting on the insulator string immediately adjacent to the break are as shown in Fig 2. The force resisting further swing of the insulator string is:

$$P_n = \frac{W_n d_n}{i_n \cos\theta} = \frac{W_n}{\sqrt{\left(\frac{i_n}{d_n}\right)^2 - 1}} \qquad (1)$$

where W_n = $\frac{1}{2} W_{1n} + W_{2n}$, lb
W_{1n} = weight of insulator string, lb
W_{2n} = weight of conductor supported by string, lb
d_n = horizontal displacement, ft
i_n = insulator string length, ft

Data for plotting the P_n curve in Fig 4 can be determined from equation (1) for various values of d_n.

The intersection of the P_n and H_n curves, as functions of d_n, gives desired tension in the span adjacent to the break. The H_n curve cannot be calculated directly, but points can be determined using a step-by-step process, starting with assumed values of H_1, the horizontal tension in the span adjacent to the virtual or actual deadend. In the second span from the break, forces acting on the lower end of the insulator string are as shown in Fig 3. The horizontal component of tension in the conductor of span n is:

$$H_n = H_{n-1} - P_{n-1} \qquad (2)$$

where

$$P_{n-1} = \frac{W_{n-1}}{\sqrt{\left(\frac{i_{n-1}}{d_{n-1}}\right)^2 - 1}}$$

and

H_{n-1} = horizontal tension in adjacent span, lb

From Fig 1, the horizontal displacement,

$$d_n = \phi_n + d_{n-1} \qquad (3)$$

where

$$\phi_n = L_{on} - \frac{2H_n}{W} \sinh^{-1}\left\{\frac{\left[H_o \sinh\left(\frac{wL_{on}}{2H_o}\right)\right]\left[1 - \frac{H_o - H_n}{AE}\right]}{H_n}\right\} \qquad (4)$$

L_{on} = Length of span n
A = conductor cross section, sq in.
E = conductor modulus of elasticity, psi,
H_n = horizontal tension in span n after break, lb
W = conductor weight per ft, lb
H_o = horizontal tension before break, lb

Starting with span 1, H, d, and ϕ for each successive span can be calculated, one point on the H_n curve being thereby obtained for each assumed value of H_1. The H_n curve of Fig 4 can be drawn through these points. The intersection of the P_n and H_n curves gives the desired tension in the crossing span after break. The sag then can be calculated conventionally.

When the spans are not level, as in Fig 5, weight supported on each string may be found as follows:

$$h_n = D_{n-1} - D_n \qquad (5)$$

$$x_n = \frac{L_{on}}{2} - \frac{H_o}{w} \sinh^{-1}\left(\frac{w h_n}{2H_o \sinh\frac{wL_{on}}{2H_o}}\right) \qquad (6)$$

(*Continued on next page*)

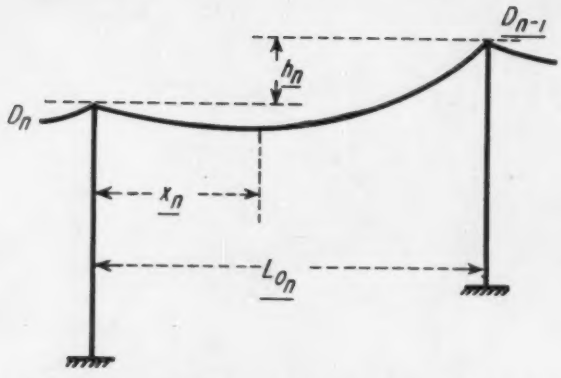


FIG 5—SLOPING SPAN is added complication but can be handled by modification of the basic equations

For the string adjacent to the break:

If $h_n \geq 0$,

$$w_{2n} = wx_n \tag{7}$$

If $h_n < 0$,

$$w_{2n} = w\,(L_{on} - x_n) \tag{8}$$

For succeeding strings:

If $h_{n-1} \geq 0$, and $h_n \geq 0$,

$$w_{2(n-1)} = wL_{on} - wx_n + wx_{n-1} \tag{9}$$

If $h_{n-1} < 0$, and $h_n \geq 0$,

$$w_{2(n-1)} = wL_{on} - wx_n + w[L_{o(n-1)} - x_{n-1}] \tag{10}$$

If $h_{n-1} \geq 0$, and $h_n < 0$,

$$w_{2(n-1)} = wx_n + wx_{n-1} \tag{11}$$

If $h_{n-1} < 0$, and $h_n < 0$,

$$w_{2(n-1)} = wx_n + w\,[L_{o(n-1)} - x_{n-1}] \tag{12}$$

Before a problem can be solved on an electronic computer, it is usually necessary to flow chart the work (see Fig 6). A sequence of instructions then is prepared to tell the computer how to do the charted work and effect a solution. This step-by-step set of orders is called a "program", and is in a "code" or "language" acceptable to the machine. Programs may be written directly in basic machine language, or, more simply, in symbolic notation to be interpreted and coded later in machine language by the computer itself.

One routine for accomplishing this latter result is SOAP (Symbolic Optimal Assembly Program), prepared by International Business Machines Corp for its 650 magnetic drum data-processing machine. The SOAP program for the broken conductor problem consists of about 280 instructions. A maximum of 34 input quantities are required for a given crossing problem:

- conductor cross-sectional area
- conductor modulus of elasticity
- conductor weight per unit length
- conductor horizontal tension before break
- length of each span
- length of each insulator string
- weight of each string
- conductor elevation at each support

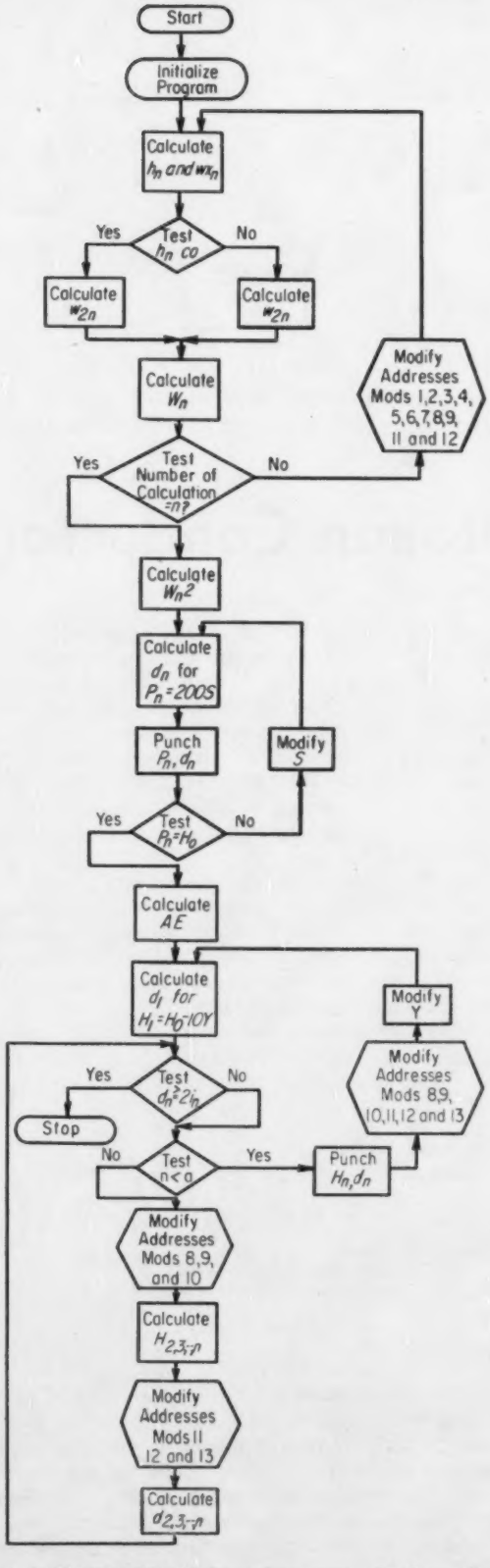
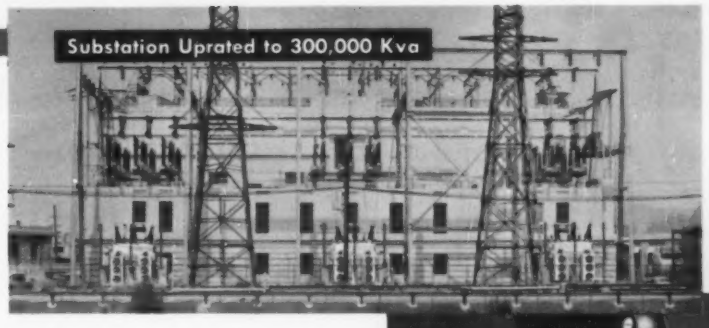


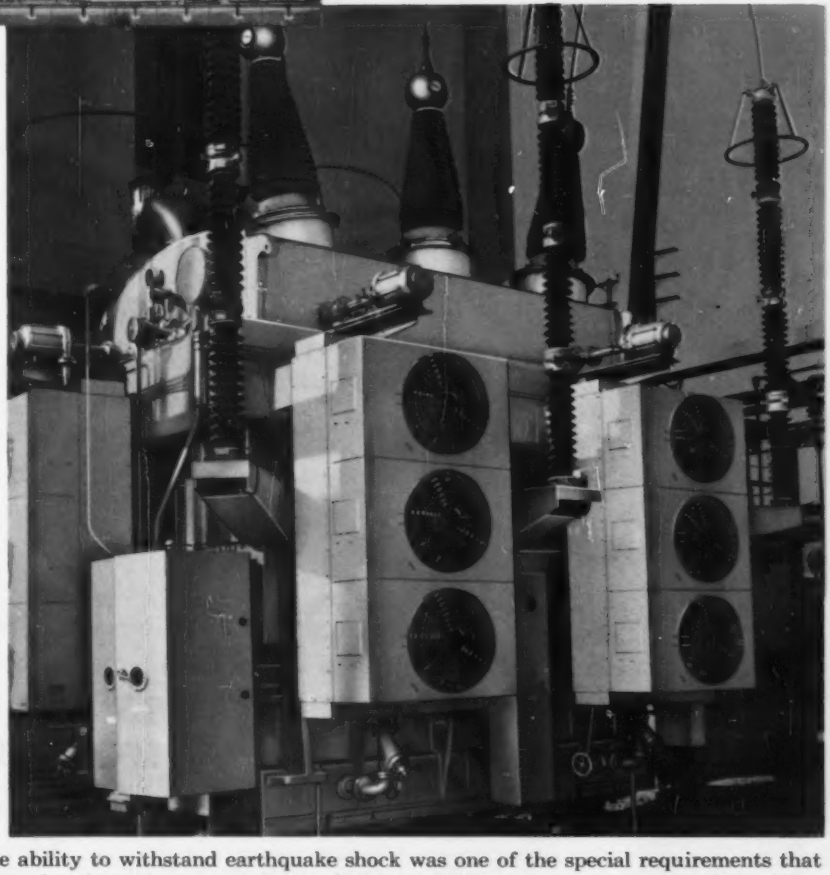
FIG 6—FLOW DIAGRAM shows movement of information in digital computer solution of broken conductor problem

For vital expansion in limited space . . . Los Angeles chose power transformers

by PENNSYLVANIA



ONE OF THREE 100,000 KVA PENNSYLVANIA POWER TRANSFORMERS located at Receiving Station A of the City of Los Angeles, Department of Water and Power. The units feature Pennsylvania's shell-form Contour Design. High voltage: 138,000 Grd.Y volts. Low voltage: 34,500Y volts.



Completed in 1917, Receiving Station A was the first substation constructed for the City of Los Angeles' power system. When expansion ultimately became necessary, studies indicated a need for 300,000 kva, or two-and-a-half times the existing capacity of 120,000 kva. Since no new station sites were available in the area, this expansion had to take place within the relatively limited confines of the original station.

Three 100,000-kva Pennsylvania Power Transformers were chosen to step down the transmission voltage of 138 kv to the 34.5 kv utilized by the station's distribution system. Because of the compact shell-form Contour Design of these three-phase transformers, the needed increase in kva capacity was achieved with room to spare. In addition, compactness and ease-of-handling simplified the job of first placing the transformers in temporary locations and then permanently positioning them so that two units always were in service, thus keeping the station in operation.

The ability to withstand earthquake shock was one of the special requirements that Pennsylvania engineers satisfied in designing these transformers for the City of Los Angeles. Whether your own power transformer requirements are just as unusual or strictly standard, Pennsylvania has the experience and the facilities to meet your needs. Contact Pennsylvania Transformer Division, McGraw-Edison Company, Box 330, Canonsburg, Pa.

McGRAW EDISON

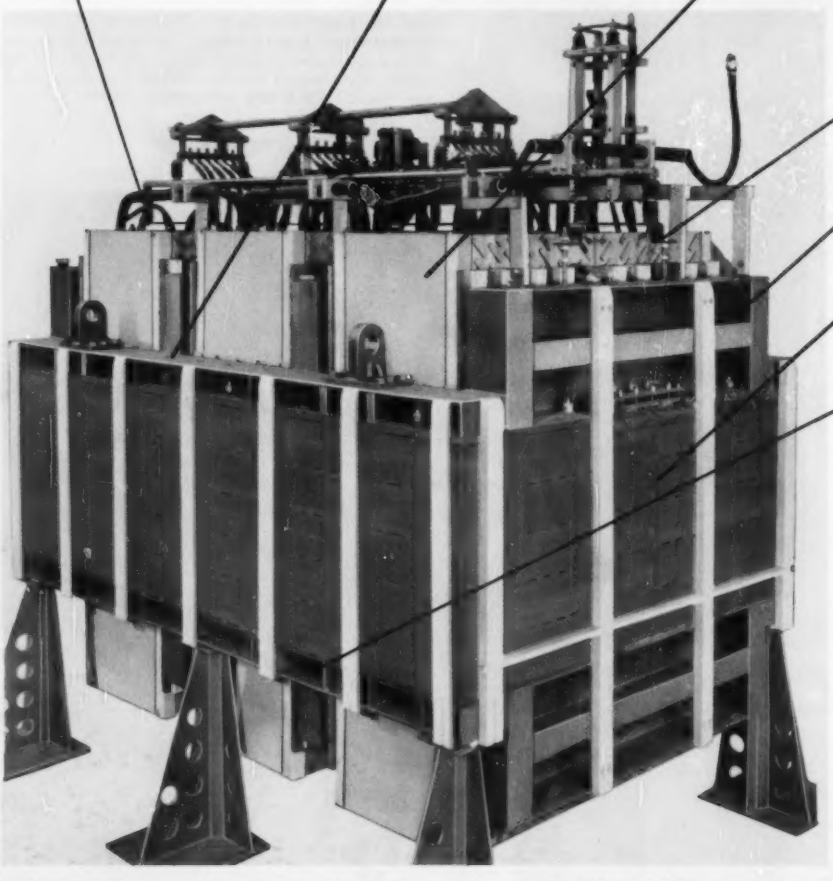
PENNSYLVANIA TRANSFORMERS

PENNSYLVANIA POWER TRANSFORMERS

See other side for design details

One of Three at Los Angeles Receiving Station "A"...

100,000 Kva THREE PHASE CONTOUR DESIGN Pennsylvania Power Transformer


Leads supported in securely-braced insulating tubing.
Core and coils clamped together with fabricated steel members. Core-and-coil unit can be handled separately as complete assembly.
Vertical cooling ducts in coils permit free flow of oil for efficient cooling.
Tap changer supports securely bolted to frame members.
Sturdy, fabricated box sections of core frame clamp coils to protect against mechanical forces during short circuits.
Core cooled by both vertical and horizontal ducts.
When core-and-coil assembly is tanked, bottom frame member rests on flange of lower tank section.

Designed to Withstand Earthquake Shock

100,000 kva, three phase, 60 cycles, 55°C. temperature rise. Forced-oil, forced-air-cooled. High voltage: 138,000 Grd.Y volts. Low Voltage: 34,500Y volts. Shell-form Contour Design.

PENNSYLVANIA HAS THE *FACILITIES* AND THE *CAPABILITY* TO MEET THE LARGEST POWER TRANSFORMER REQUIREMENTS...

- A large, expertly-staffed engineering department with long experience in power transformer design—both core form and shell form.
- The ability to design and construct scale models for proving design characteristics.
- A modernly equipped plant capable of producing and testing the highest rated units contemplated by industry today.
- Handling and loading facilities that permit full utilization of manufacturing, shipping and installation economies.

McGRAW EDISON

PENNSYLVANIA pt TRANSFORMERS

PENNSYLVANIA TRANSFORMER DIVISION

McGraw-Edison Company

CANONSBURG, PENNSYLVANIA Greater Pittsburgh District

See other side for installation view . . .

To calculate load flow problems, which should it be . . .

The Analog or the Digital Computer?

Based on experience with both types of computational facilities, the authors outline how each method will find a place in the solution of load flow problems

R. B. SQUIRES, Manager, Technical and Computer Section, Switchgear Division,
L. J. RINDT, Engineer, Analytical Department, Westinghouse Electric Corp, East Pittsburgh, Pa.

Digital computers appear to offer new and wide possibilities to the electric utility engineer for the solution of many engineering problems. The computer is being applied to problems for which manual calculations or analog computers have been the accepted means of obtaining solutions. One most important problem in this category is the determination of load flow. Thus, it is only natural that the utility engineer should want to both investigate the possibility of using a digital computer and re-examine the use of the ac network analyzer in solving power system load flows. Based on experience in working intimately with the ac network calculator and a large-scale digital computer facility in solving load flow problems, the authors present an evaluation of both means in terms of economics, time required, preparation of data, accuracy of solution, and certain intangible, but important, factors.

In evaluating these two computational facilities, pertinent characteristics of the problem should be presented. Load flow studies are undertaken in connection with long range planning, short range planning, and loss formula preparation. Long range planning looks at the immediate future and also indicates the direction in which planning should proceed beyond this time. One or more plans are investigated under normal conditions at various future load levels and a few major outages or power transfers are studied to ascertain the system's flexibility and strength. Variations from the normal cases are limited to a few. Long range planning studies generally require many major changes during the course of the study. As more of these changes are made, it becomes increasingly difficult to predict accurately how the system will operate.

Planned Outages Studied

Short range planning looks at present and past system conditions. Following the long range guide, it determines the fine points necessary for the actual development of the system. Many tests of emergency and planned outages are studied to determine detailed information about system design and operation. Thus, in short range planning, the number of major changes from the normal are few. In addition, the planning engineer usually can predict more accurately the effects of changes from study to study.

Preparation for loss formula requires the results of a number of load flow cases. These cases differ from those discussed in that additional readings are taken. The only variations in the system are those due to variations of existing generation and loads. Except for a few load changes, there are not any major changes from the normal case. Although some studies fall into only one of these categories, a particular study generally is a combination of two or all of them.

With the load flow problem thus defined, the next step is to outline the procedures used and experience with the network calculator and the digital computer. System data is set into the network calculator as the impedances of such network elements as lines and transformers, the watts and vars at each load, the system connections, and the power and voltage at generating points. Connections are made, lines and transformers set and checked, and loads and generators brought into adjustment.

The first study usually is a "base case" in which the proposed system is examined in detail for workability. The procedure leading to the base case often becomes not one study to satisfy one set of requirements, but rather a series of studies to determine what the problem is and how to achieve the most workable system. Changes made in approaching the base case show their effects instantly and can be accepted or rejected by taking only a few readings. The comparative ease of making changes permits immediate decisions

Examples of Digital Computer Printout

DATA FOR EACH BRANCH

			Flow from Row		Flow into Col		Line Losses	
Branch	Row	Col	Mw	Mvar	Mw	Mvar	Mw	Mvar
1	1	17	42.630	42.182	42.529	38.781	.101	3.401

DATA FOR EACH BUS

Node	Bus	Type	Mw	Mvar	E Pct	Ang	ResP	ResQ
1	Penn Hills	Gen	78.00	53.09	106.000	9.389	.0048	.0000

without recording complete information on the entire system.

The ability to combine many studies into a "base case" study is one of the major advantages of the network calculator. When the base case is satisfactory in general, the system is balanced by bringing generation and loads to their scheduled values. All elements then are metered and recorded on a diagram of the system.

Subsequent studies dealing with variations from the base case will usually be recorded only in the area of interest, such as the part of the system adjacent to a switched-out line. The network calculator is well adapted to making these partial readings to get only essential data; the user is not burdened with repetitive information.

Use of an automatic recording for the network calculator will slash recording time to one-third or less of its present value. A long carriage electric typewriter automatically types voltage, watts, and vars for each line and bus on a diagram of the system. Automatic recording results in a significant reduction in overall study costs at a moderate increase in the cost of the network calculators.

Some factors in the digital solution to the load flow problem can best be pointed out through a description of the input and output of the digital program and a general description of how a program obtains a solution. This specific program, which is familiar to the authors, has been written for an IBM 704 computer with 4096 word core storage. It is one of a group of electric utility programs which the Westinghouse analytical department has available at East Pittsburgh.

Input to the load flow program is of the same type, but of a different form, as that used for a network calculator study. The major exception is that some final bus conditions are estimated. Although these estimates are not necessary to the solution, computation time is reduced by good estimates. This procedure is used in supplying data: A system diagram is prepared with buses (nodes) and each branch numbered. A branch is any element connected between two buses or from a bus to ground, except for loads, generators, and in some cases, synchronous condensers. After the diagram is numbered, each bus and branch is defined with pertinent data.

Digital Input Data

In the case of buses, these data consist of the type (generator, load, generator with load, etc), bus number, fixed data (MW, voltage magnitude, etc), and estimated variable data. A branch also is described as to type (transformer, π-line, etc), branch number, node connections, and fixed data (impedance or admittance, transformer tap setting, etc). Names of buses and some general information concerning the base, number of buses, and branches, and convergence criteria complete the digital input information. Only those data which change from one study to the next are required as additional cases are considered.

In general, to perform the computation, input data are fed into the computer and stored in assigned locations. The solution is obtained with an iterative process which uses initial estimates and various network parameters to compute various branch flows. Summation of these flows at each bus represents the load or generation at that bus. Comparing these computed values with scheduled values gives a residual P, Q or voltage at each bus. These values of residuals then are used to modify the estimates at each bus. After a number of iterations, when residuals on each bus are within specified accuracy criteria, the solution is said to be completed.

All data necessary for the printout are computed in a suitable form. Printout of the data is in a form as shown in the accompanying tabulation. Each branch is listed by number and occupies one row of the printout. Following the list of all branches is a summation of losses and then a listing of the buses.

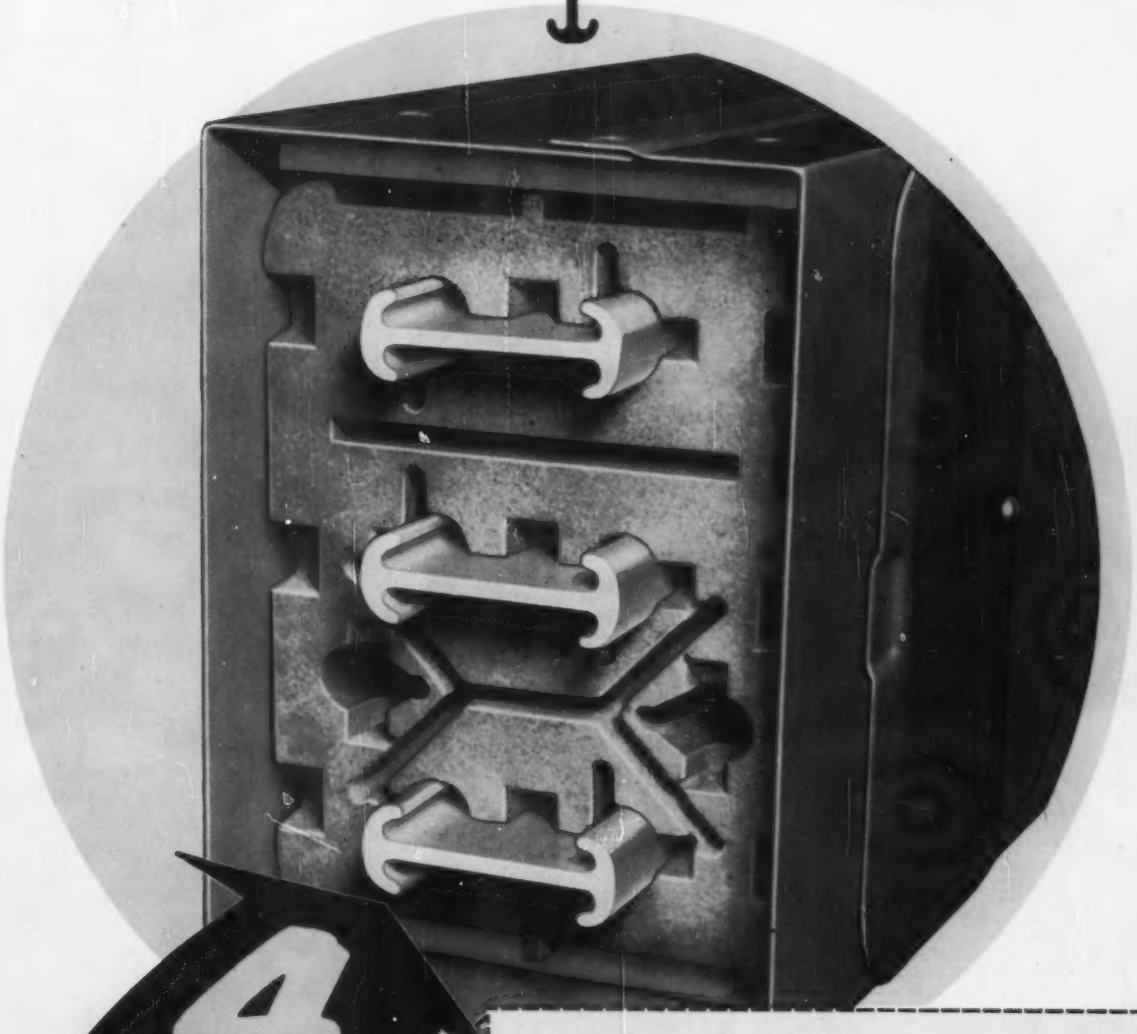
Computer time for obtaining a solution is of prime importance. This time is a function of the number of iterations required to complete the solution. This number is dependent on the accuracy of original estimates, the desired accuracy of results, and system size and configuration. Thus it is very difficult to predict the actual time for calculating the solution. To give some idea of the number of iterations required, two studies (100 cases total) were examined. For a 74-bus system, the average was 165 iterations.

These observations regarding computer time follow from an analysis of these studies. Set-up time associated with getting on the computer is 1.2 min. Input and output time is about proportional to the total number of branches and buses. For a system of 272 buses and branches, this time is 50 sec. Time in seconds for the calculation phase may be approximated by $6+Cx$ (number of iterations). Coefficient C is very nearly proportional to the number of buses (1.2 for 74 buses) for an average of three branches per bus. In these studies, solutions were solved to an accuracy of 0.001 per unit power and 0.001% voltage.

Experience indicates that for the most economical use of the digital computer the engineer will have to modify his approach to conducting a study. One factor to consider is that set-up time for each computer run is the same whether one or more cases are computed at a time. This does not imply that all cases must be run in one batch, or in several large batches. It does imply that to run each case individually will be costly. Time may be saved by relaxing the accuracy criterion. A solution with this criterion relaxed will be equivalent to a rough balance on the network calculator. If possible, consecutive studies should be chosen so that the complete or partial system under study is not completely dis-

(*Continued on page* 58)

SQUARE D's New Aluminum Plug-In Duct with Exclusive I-BEAM Design!



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Square D Company, Dept. SA-25
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Send me Bulletin SD-110 which gives the complete story of Square D's new aluminum plug-in duct.

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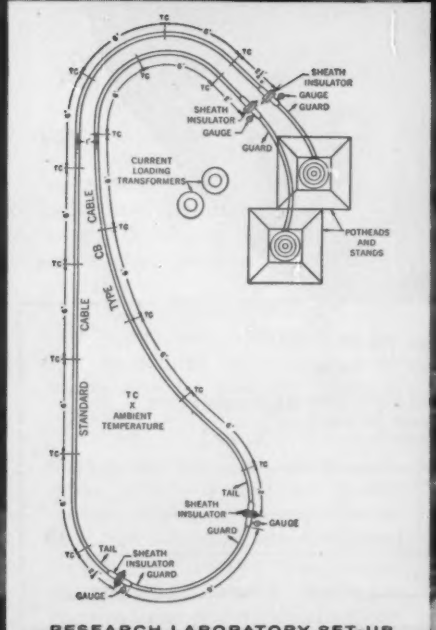
SQUARE D COMPANY

Cyclic aging test on paper-lead power cable reveals



RESEARCH LABORATORY SET-UP for cyclic aging test. Two single-conductor, 69kv shielded-type cables (one standard, one Anaconda Type CB) were spliced together to form a single cable. The cable was then subjected to cyclic aging for 404 daily load cycles. At end of test the two sections were studied—and revealed the results shown in chart at right.

Greater insulation stability...longer cable life with TYPE CB cable

Heat and electrical stress . . . heat and electrical stress—keep it up long enough and insulating oil in ordinary paper cable breaks down.

Anaconda Type CB* (Carbon Black) power cable is different. Special carbon-black tapes continually purify and stabilize the insulating oil over the life of the cable. These carbon-black tapes provide many advantages:

1. Oxidation products are removed.
2. Deterioration is reduced by continuous purification of the oil.
3. Conductor is shielded; strand discharges, and ionization discharges between insulation and sheath are eliminated; maximum stress is reduced more than 25 percent.
4. Destructive energy is reduced because the work function of carbon is much less than that of copper.
5. Surge currents are diminished.
6. Impulse strength is increased.
7. Dielectric strength and life are increased.

The over-all result is not only physical and electrical improvements, but also real economic gains for the user.

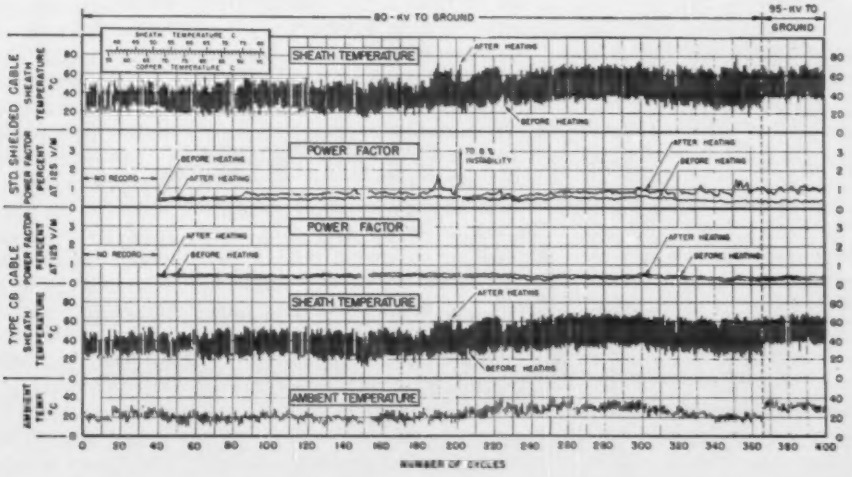
CYCLIC AGING TEST

For dramatic proof, no other test shows stability better than the cyclic aging tests.

The test shown here consisted of subjecting two single-conductor, 69kv shielded-type cables to cyclic aging for 404 daily load cycles. One cable was Type CB, the other a cable of standard construction. Both cables were still in operating condition at the end of the test. The standard cable, however, showed definite signs of aging. The Type CB cable showed no such signs.

WANT TO KNOW MORE? The Man from Anaconda will be glad to give you full information about Type CB cable. See him or write for Bulletin C-89. Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y. 58831

*CB—Carbon Black (U. S. Patents 2,102,129; 2,405,853) Reg. U. S. Pat. Off.



CYCLIC AGING CHARACTERISTICS of 1/c, 650 Mcm, 69kv solid-type paper-insulated cable, standard construction compared to Type CB construction. Power factor readings during each cycle show low and constant values for Type CB cable—0.3 to 0.5 percent for both. The standard cable, with the same initial values, increased to over 1 percent at the end of the test. Power factor readings before and after heating during each cycle are also significant. At first, both cables show "after heating" values below those for "before heating." In the standard cable, the trend is reversed (69th cycle) and the "after heating" values are higher to the end. In the Type CB cable, the "after heating" values remain below throughout the test.

LIVE BETTER ELECTRICALLY

SEE THE MAN FROM **ANACONDA**®

FOR **TYPE CB CABLE**

The Analog or the Digital Computer? (*Continued from page* 54)

turbed from study to study. As on the network calculator, this permits a minimum of change (and time) from one solution to the next.

Thus, a study might be conducted in this manner. With a list of possible studies compiled, the normal cases for on and off peak for each of the years to be studied are solved with a reduced accuracy criterion. Results of these studies are reviewed, any corrections are made, and the studies are re-run to the desired accuracy. These results then are reviewed to assure that the corrections have had the desired effect.

Remaining cases at each load level would be divided into two groups. The first group would consist of those cases which would not be contingent on the results of some other case; the second group would be the remainder. The first group would be solved in batches of five or six. Results of these would show if all of the second group should be studied and if additional cases should be run. This process would be repeated until all desired studies are completed. Although this method may not result in the most saving, it should guide the planning engineer in selecting the best procedure.

At present, digital computer experience with the load flow problem is somewhat limited. In the past several years, important contributions to the digital solution have been reported (AIEE paper 56-164 and EW, Sept 30, 1957, page 60). Indications are that improved digital computer techniques may be expected to continue. On the other hand, certain advances in the use of network calculators may be expected. Thus, the factors which influence the choice of computational facility will need to be re-examined from time to time as improvements in one or both methods are made. The authors feel these comments characterize the present situation.

Economics . . . Time and cost per load study on the network calculator vary greatly with the extent of the system, advance preparation, etc. Records on the Westinghouse network calculator at East Pittsburgh indicate times from 1 to 4 hr and costs from $25 to $200 per study. The higher figure in each case is for the largest systems and for studies requiring complete recording of each case. Ratio of manual recording to total time varies from 40 to 60%.

Direct economic comparison of the digital solution is difficult because almost no problems have been solved using both facilities. It is difficult to estimate digital computer time for doing studies which have been done on the network calculator because of the wide variance in systems and types of studies. Consequently, the best that can be done is to compare completed digital computer studies with estimates for the same studies on the calculator.

The 100 cases cited earlier were from two studies to obtain data for a loss formula. In these studies, no system changes were made. Although an average of five different load levels was studied for each system, the changes generally made from case to case were rescheduling of generation.

Analysis indicated that total cost of the digital solution was about the same as the estimated cost for the same work on the network calculator, in spite of a large engineering cost. This high engineering cost was due to the necessity for close supervision of the initial use of this particular program. These engineering costs are expected to diminish with experience. This comparison is based on rates at the Westinghouse facilities in East Pittsburgh.

Machine Time . . . The time required to solve a load flow problem on a network calculator comprises the initial setting-in and checking of the base case, recording of data, and subsequent changes and recording of data affected by these changes. The initial set up may take from one-half to somewhat over a day, depending on system size and complexity. As noted previously, automatic recording will cut recording time significantly.

Machine time for a given digital computer solution is quite small compared to the time to obtain this same solution on the network calculator. Because the digital computer does not stand idle between cases, there will be a tendency to spend more time analyzing results. Thus the engineering time spent conducting a digital study might be as long as that spent with the network calculator.

With digital facilities, such studies might be conducted over a period of time rather than doing a large group at one time. If this is done by mail, the more or less continuous load flow study would permit interested parties to examine results at their convenience before proceeding.

Data Preparations . . . Considerable preparation must be made to use either the network calculator or the digital computer to solve a load flow case. To obtain the most economical digital solution, some additional effort must be spent to estimate variable conditions. With this exception, data needed for either method of solution are the same. One improvement would be a digital program which does not have these estimates as a necessity for an economical solution.

Accuracy . . . The digital solution of any load flow study is an exact solution, within the limits of machine accuracy, in this sense: Various power flows (line, loads, generators, etc) are calculated from printed voltage and angles and network impedances. Accuracy of the solution is the difference between the values of scheduled quantities and these same quantities printed out. Availability of high accuracy may be important in particular problems, such as loss studies. In many other types of studies, high accuracy is of limited value because of uncertainties of future loads, etc. In these cases, digital studies will have accuracies similar to network calculator studies, with a subsequent reduction in time.

Errors in recording output data are practically nil with the digital solution. In rare instances, there may be a machine malfunction. When this occurs, the entire output is usually distorted and these errors are more easily discernible than an occasional sign or magnitude error in hand recording. Recent availability of automatic recording network calculator data has given a similar advantage to those network calculators so equipped.

Intangibles . . . Network calculators used on a rental basis now are scheduled from six months to two years in advance, which makes scheduling of an urgent study difficult on short notice. For a complete digital study handled by mail, this time might be reduced, depending

(*Continued on page* 85)

WHEN you consider expansion...
the most important investment
you can make is in
the creative ability of men.

Experimental "air lift" speeds power-line construction in rugged mountain area. Helicopter carries tower components to remote sites, and strings cable.

FLUOR

The Fluor Corporation, Ltd.
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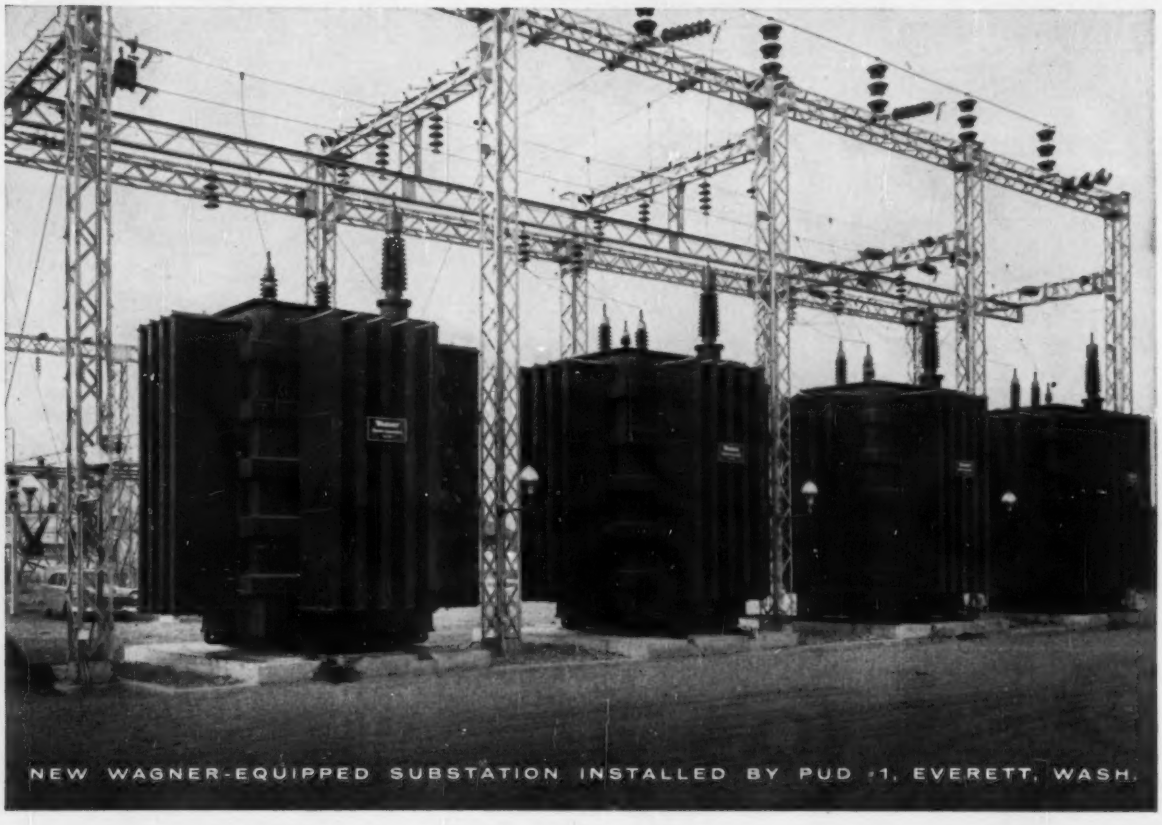
2500 S. Atlantic Blvd., Los Angeles

MORE WAGNER TRANSFORMERS

add system capacity for Snohomish County



NEW WAGNER-EQUIPPED SUBSTATION INSTALLED BY PUD #1, EVERETT, WASH.

With system demand growing at the rate of 9% annually, Snohomish County PUD is adding capacity with more and more transmission and distribution substations.

This recently completed substation is equipped with four Wagner single-phase power transformers rated 10,000/13,333/16,667 kva, 110,000 GrdY to 55,000 Delta Volts.

Wagner builds standard and special power transformers to meet practically all kva and voltage requirements. Consult Wagner about your next power transformer installation. 32 branch offices are at your service. Wagner Bulletins TU-181 and TU-16D tell the whole story. Write for your copies today.

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ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

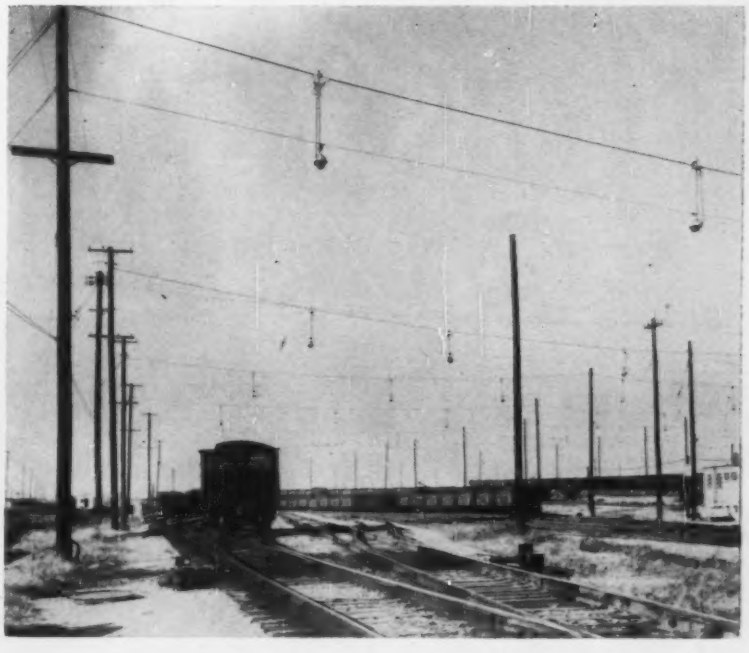
'Skyhook' Lights Cut Glare, Minimize Shadows

A. W. KANITZ, Field Engineer, Line Material Industries, Milwaukee, Wis.

Flexibility in locating luminaires to light the Chesapeake & Ohio Railway Company's multi-million dollar coal handling facilities at Newport News, Va., is provided by a unique "sky-hook" type of catenary suspension.

Stranded copperweld cables were strung in pairs in spans up to 300 feet. They support from two to five luminaires each. Spacing between catenaries varies from 100 to 200 feet, depending on the area and the desired level of illumination. Chief advantages of the catenary system, compared to conventional flood lighting from high towers, are controlled distribution of light, minimum glare, and elimination of sharp shadows.

Each of the 135 mercury-vapor luminaires uses a 7,000-hour lamp with a light output of 21,000 lumens. Refracting glassware provides uniform light distribution, even from the 40-foot mounting height used above the yards.



Luminaires are serviced from a telephone-type cable cart suspended from the lower messenger cable. The cart is readily moved between luminaires and does not interfere with normal railroad yard activities.

Heating Cable Beats Cold Weather Slowdown in Feed Mill

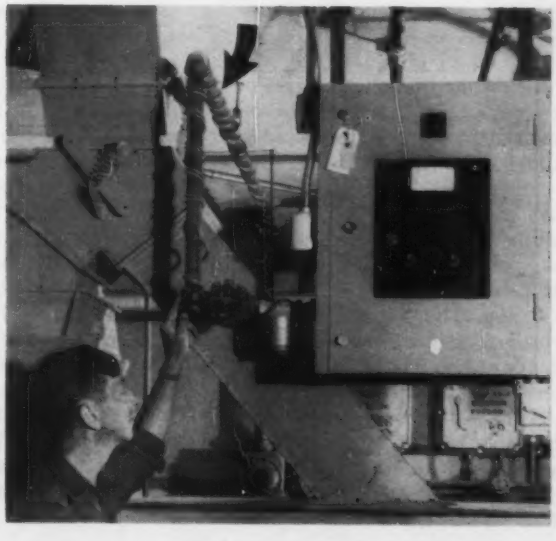
LARRY FLYNN, Industrial Power Engineer, West Penn Power Co, Connellsville, Pa.

An uninterrupted flow of molasses, fish oil, and other liquid ingredients required for the automated mixing of livestock feed is assured by an installation of electric heating cable at the Allied Mills in Everson, Pa.

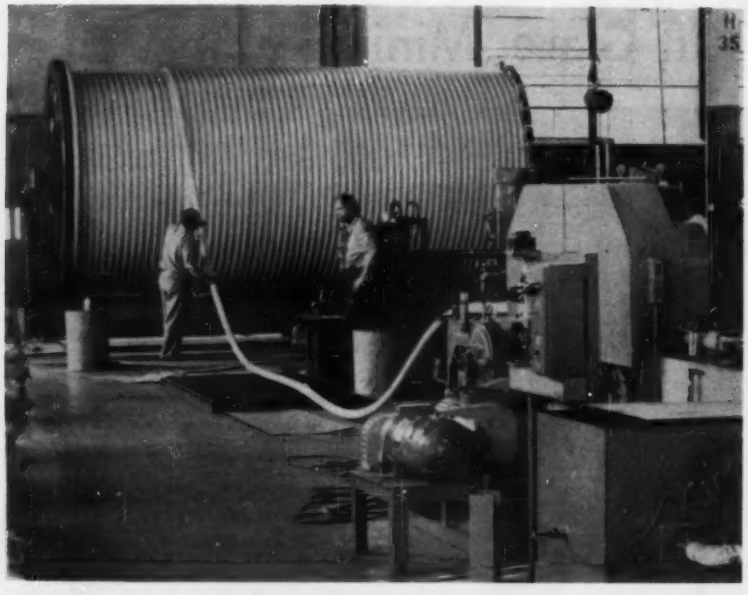
Wrapped around the 1½-inch pipes which carry the fluids from the outdoor storage tanks to the process area, the dependable electric cable helps keep the materials fluid and free-flowing despite low temperature conditions. The supply to the cable is thermostatically controlled so that only the power needed is applied.

The installation uses a total of 120 ft of cable, rated 6.5 watts per foot and operated from a 115-v supply. Without the heating cable installation, flow of these fluids is slowed down and even interrupted when the outside temperature falls.

(*More Selling on page* 80)



Manufacturers News



Okonite Ships 2½-Mile Submarine Cable

One of the longest lengths of plastic insulated submarine power cable manufactured was shipped recently by The Okonite Co from its North Brunswick, N. J., plant to the Pacific Coast. This cable is 3 in. diam and 2.5 miles long. Insulated and sheathed with polyethylene, the 16.5-kv, 3-conductor cable is capable of carrying more than 3,500 kva. It is to be installed this month to a Standard Oil Co of California off-shore drilling rig near Santa Barbara. This is the first of this type operation on the Coast.

Shown above, the cable is being wound on a preliminary reel. It was then rewound on another reel on a flat car. This latter reel of cable weighed 55 tons and measured 10.5 ft high, 10.5 ft wide and 22 ft long.

Polyethylene was selected as an insulating material because it was felt that the high dielectric and moisture resistant qualities would make the cable suitable for submarine application. The polyethylene jacket, which is yellow, was specified by Standard Oil. The color will distinguish the cable from the pipelines and hoses in the area and identify the cable readily in the event it is pulled up at a future date.

The cable has three No. 2 stranded conductors with a layer of semi-conducting tape. Individual conductors are covered with red, yellow and black Okolene (polyethylene). Each insulated conductor is then covered with a layer of semi-conducting Okoprene (Neoprene) and shielded with untinned copper tape. These conductors are cabled together with preservative-treated jute with one pair of No. 16 Okolene insulated wire in each interstice. Over this is a cushioning layer of jute and No. 8 BWG galvanized steel wire armor. The entire construction is jacketed with a wall of yellow Okoprene.

The three pair of small cables in the interstices are to be used for communications, the transmission of alarm functions from the platform to shore, and remote control after the wells begin to produce.

At installation the cable will descend from a high bluff vertically to the beach. Here it will be buried in a trench through the surf at a depth averaging 10 ft.

From this point the cable will be laid through heavy kelp beds extending approximately 1½ miles from shore, then to the drilling platform where the depth is 100 ft. Approximately 20 wells will be sunk from the platform by directional electrical drilling.

High-Current, Voltage Test Set Marketed by Multi-Amp

A portable multi-purpose instrument for testing a wide range of protective devices and power equipment is the latest development of Multi-Amp Corp, Union, N. J.

This test set has two sections—a 15-kva unit capable of producing short-time currents up to 15,000 amp, and an auxiliary 5-kva, 40-kv transformer section for high potential testing.

The set has built-in instrumentation for testing: (1) Oil circuit reclosers for minimum trip current, time-current characteristics, operation and insulation resistance; (2) Direct acting heavy duty circuit breakers; (3) Protective relays of induction-disc and motor-overload types; (4) Current and potential transformers including bushing types for winding ratios; (5) Primary voltage regulators; (6) Street lighting devices; (7) Distribution transformers up to 333 kva for insulation and impedance; (8) Light and heavy equipment at potentials up to 40 kv.

Gas-Steam-Hydro Plant Uses Wheeler Condenser

Serving in a unique generating station is a 10,000 sq ft dual bank steam condenser made by C. H. Wheeler Mfg. Co., Philadelphia, Pa.

The equipment is in a station planned as a combined gas-turbine, steam-turbine plant to supplement a hydro plant. It is the Warwick Station of Crisp County Power Commission, Cordele, Ga. The combination of gas-turbine and steam-turbine generator can be operated independently or in conjunction with the hydro system. It is expected to satisfy daily peak-load conditions, along with base-load requirements in low-water periods.

In the thermal operation some of the exhaust gas from the 5,000-kw gas-turbine is used for combustion air in the steam boiler which supplies the 12,500-kw steam-turbine generator unit.

(*More Manufacturers News, page* 65)

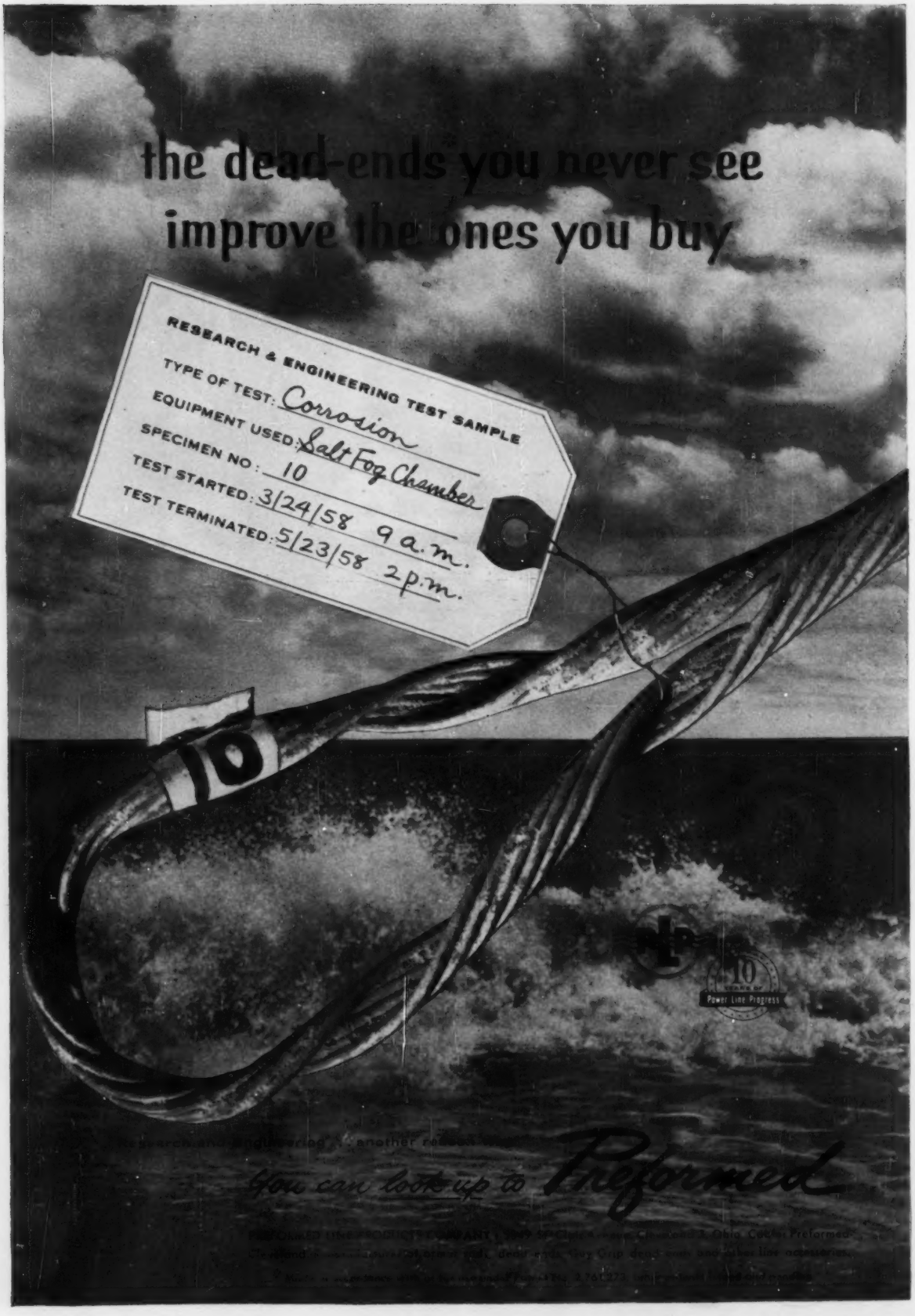
TOUGH!

Husky Herman is getting nowhere fast. He ought to know it takes a lot of doing to damage one of VICTOR's Apparatus Insulators!

Here's why: They are designed to withstand steep front wave impulse in addition to the normal 1.5 x 40 standard impulse. They are manufactured and tested with the industry's most modern equipment. They're made of Purified Porcelain—toughest, most durable porcelain ever made. Scientifically fitted glaze, properly and uniformly applied, gives maximum strength and protection against contamination. Precision manufacture and accurate alignment of shells, cap and pin in tempered, cast-iron jigs produce an accuracy that makes stacking fast and easy. Joining of component parts with premium grade insulator cement gives maximum tension, torsional and cantilever strength. Vigorous high frequency and 60-cycle flashover tests follow routine mechanical tests on every unit.

VICTOR No. 729 Apparatus Insulators are tough, dimensionally accurate, give exceptional service. Insist on highest quality. Insist on VICTOR.

I-T-E CIRCUIT BREAKER COMPANY, INC.
VICTOR INSULATORS DIVISION
Victor, New York


the dead-ends you never see
improve the ones you buy
RESEARCH & ENGINEERING TEST SAMPLE
TYPE OF TEST: Corrosion
EQUIPMENT USED: Salt Fog Chamber
SPECIMEN NO: 10
TEST STARTED: 3/24/58 9 a.m.
TEST TERMINATED: 5/23/58 2 p.m.
10
10 YEARS OF Power Line Progress
You can look up to Preformed

Marblehead Uses Polyethylene Cable

A 15-kv preassembled aerial power cable featuring polyethylene insulation has been installed recently by Marblehead (Mass.) Municipal Light Dept. The cable also features a flame-retardant polyethylene jacket (Roseal) as well as polyethylene insulation. This cable is a product of Rome Cable Corp, Rome, N. Y.

Shown is a Marblehead lineman guiding the cable from the pay-off reel to the first sheave while another lineman can brake the reel to slow down the pay-off if necessary. After installation and before energizing, the entire cable circuit was given an acceptance test with a dc tester.

This choice of cable as William K. Goodwin, Marblehead manager, calls it, is an indication of Marblehead's "do-it-now" philosophy. He says, "We like to try new products and methods. Let's let progress work for us. Until something better comes along we'll keep on using polyethylene because of its attractive cost, ease of handling, and operating advantages."

In Marblehead's new installation, all of the feeders will be aerially installed cable. A new line is under construction from Lynn Gas & Electric Co, the supplier of about 95% of Marblehead's power.

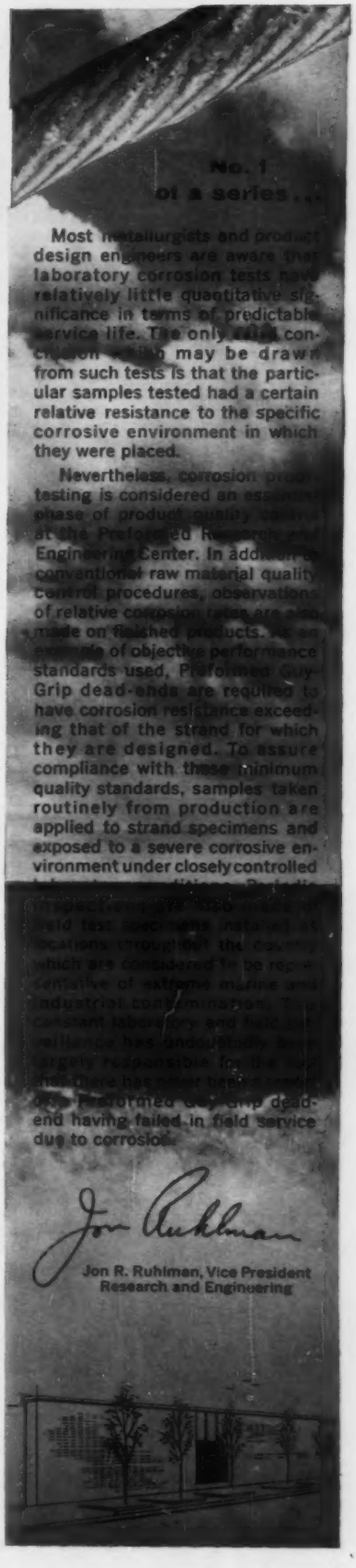
The municipality has had experience with polyethylene. This insulation has been used on line wire, service drop and underground cable now in operation. Two years ago a 5-kv unshielded underground cable with polyethylene was installed.

Westinghouse Reports on Expansion, Shipments

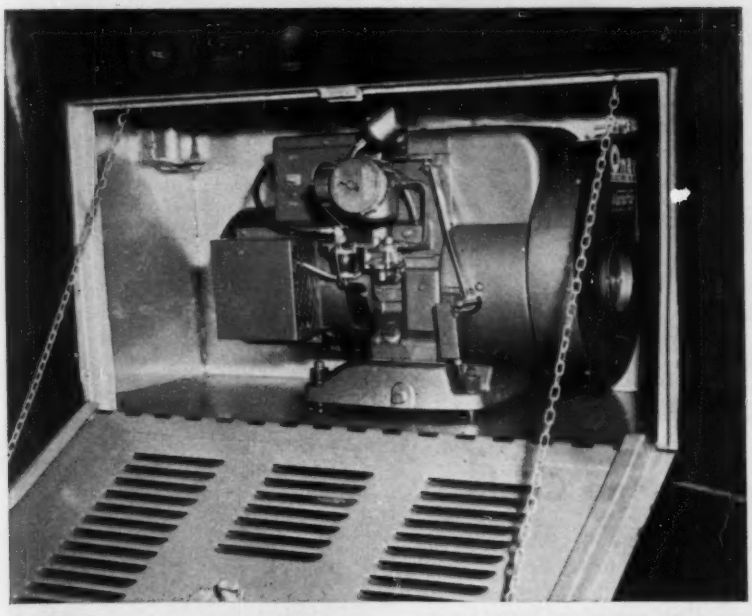
• A multimillion dollar power transformer plant in Muncie, Ind., will be an additional manufacturing unit of Westinghouse Electric Corp's transformer division, according to John H. Chiles, Jr, vice-president of the division. The plant will be located on a 300-acre tract. Production is expected to begin in late 1961 or early 1962. Employment may be more than 2,000 persons. Tentative plans are to produce largest transformers at Muncie and rearrange the Sharon plant for expanded production of medium and small power transformers. Other transformer plants are located at Greenville, Pa., and Athens, Ga.

• A 15,000-mva, three-pole, 230-kv, 1,600-amp tubular grid circuit breaker is in operation at the Niagara Mohawk Power Corp's Huntley Station, near Buffalo, N. Y. The three tanks were shipped assembled on a unit base mounting to speed installation.

(*Continued on page* 66)


No. 1
of a series...
Most metallurgists and product design engineers are aware that laboratory corrosion tests have relatively little quantitative significance in terms of predictable service life. The only valid conclusion which may be drawn from such tests is that the particular samples tested had a certain relative resistance to the specific corrosive environment in which they were placed.
Nevertheless, corrosion product testing is considered an essential phase of product quality control at the Preformed Research and Engineering Center. In addition to conventional raw material quality control procedures, observations of relative corrosion rates are also made on finished products. As an example of objective performance standards used, Preformed Guy-Grip dead-ends are required to have corrosion resistance exceeding that of the strand for which they are designed. To assure compliance with these minimum quality standards, samples taken routinely from production are applied to strand specimens and exposed to a severe corrosive environment under closely controlled
end having failed in field service due to corrosion.
Jon R. Ruhlman, Vice President
Research and Engineering

ELECTRIC PLANT NEWS



New dual-purpose Onan plants deliver A.C. power for tools; 30 amps for battery charging!

1,000 and 2,000-watt models available

Mounted in maintenance and construction vehicles, these two new Onan Electric Plants cut costs two ways.

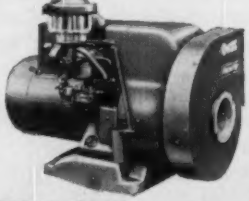
First, they provide plenty of plug-in A.C. power for floodlights and motor-driven tools.

Second, they keep communication batteries charged without running the truck engine. The 30-ampere, 12-volt output handles the drain of 2-way radio and battery-powered lighting.

The difference in fuel cost between the single-cylinder Onan engines in the 2 to 4 H.P. range and truck engines of 150 H.P. or more has been reported as high as $800.00 per year or approximately twice the cost of the 1KW plant. To these fuel savings must be added savings in engine maintenance and reduction in labor costs.

These plants can be mounted within the truck body or above the cab in an Onan weatherproof steel housing. Leading body builders will install them to order. Plants are electrically started from the truck cab. Separate charging circuit keeps starting batteries charged. Call your Onan distributor for the whole story.

OVER-THE-CAB MOUNTING
Protected by Onan steel housing. Plant easily accessible. Entire unit can be transferred to new truck.



MODEL 1AJ-1RV1330
1,000 watts, 115 volts, 60-cycle with 30-amp. 12-volt battery charging output. One-cylinder, air-cooled Onan AJ engine.

See your Onan distributor or write for information

D. W. ONAN & SONS INC.

2832A University Ave. S.E., Minneapolis 14, Minnesota

ELECTRIC PLANTS • AIR-COOLED ENGINES • KAB KOOLER • GENERATORS

Onan ELECTRIC PLANTS

Westinghouse Reports

(*Continued from page* 65)

• Three 19,200-kw hydroelectric generators are being constructed for the Portland General Electric Co, Portland, Ore. When completed each machine will weigh 235 tons.

• A two-section, 150,000-sq ft surface condenser to serve a supercritical presure turbine-generator unit has been shipped to the Eddystone station of the Philadelphia Electric Co. Each of the two sections contains 12,830, 30 ft long tubes. The condenser requires 200,000 gpm of water through the tubes.

• To further strengthen the company's position in the microwave tube and devices field, Westinghouse Electric Corp has established a microwave center in Ithaca, N. Y.

Preformed Devices Usable on AAAC, 5005 Conductors

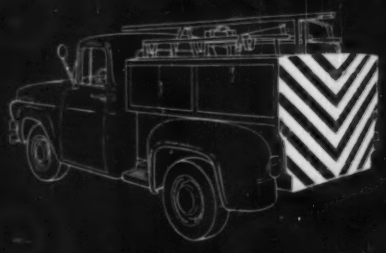
Preformed Line Products Co, Cleveland Ohio, now has available a full line of preformed accessories in all sizes for the Kaiser Triplex AC (AAAC) conductors and for the Reynolds 5005 aluminum alloy conductors.

These new products of a preformed design are—armor rods, line splices, dead-ends, and patch rods. They may be used interchangeably on the alloy conductors and without special tools.

I-T-E Acquires Canadian Producer of Insulators

I-T-E Circuit Breaker Co, Philadelphia, Pa., has acquired the outstanding capital stock of Canadian Porcelain Co Ltd. of Hamilton, Ontario. Consideration was $565,000 cash (Canadian) and 10,000 shares of I-T-E common stock. Carl Morden, former general manager, is president and general manager.

Canadian Porcelain manufactures and sells in Canada and abroad a line of high-voltage porcelain insulators for transmission and distribution systems. These products complement those of other I-T-E Canadian subsidiaries. Research and development facilities are to be expanded by the addition of a 1.5 million volt impulse generator.



reflective markings end danger after dark

Where there is danger, colorful markings of bright "Scotchlite" Reflective Sheeting flash a vivid warning to nighttime motorists. These durable, low-cost markings protect your own equipment, too. You show your concern for public safety. And you remind the public of your vital 24-hour-a-day service. Send for informative free booklet today.

REG. U. S. PAT. OFF.

SCOTCHLITE

BRAND

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MINNESOTA MINING AND MANUFACTURING COMPANY
where RESEARCH is the key to tomorrow

PRODUCT OF 3M COMPANY RESEARCH

The term "Scotchlite" is a registered 3M Company trademark

FOR **FREE** BOOKLET ON REFLECTIVE MARKINGS, WRITE 3M COMPANY, DEPT. QW-778, ST. PAUL 6, MINNESOTA

How Westinghouse Plowback of Earnings into Research brings you

POWER CIRCUIT BREAKER DESIGN AND PERFORMANCE IN A DISTRIBUTION BREAKER

A forward-looking breaker design program, coupled with thorough High Power Lab testing, produced the Type G frame-mounted, single-tank breaker . . . providing system protection and continuity of service unmatched in the industry! These distribution breakers are designed to the ASA Large Power Breaker Standards.

Top coordination of system relaying can be provided by separate phase and ground relays. Any type or combination of relays can be used to provide maximum flexibility. Varying system requirements can be met without changing basic breaker components.

The magnetic De-ion® grid and solder-sealed condenser bushing were adapted from big breakers to offer reliable high-voltage breaker performance.

Exhaustive High Power Lab testing proved the soundness of the single-tank design . . . assuring big savings in inspection, adjustment and maintenance, plus the most efficient utilization of oil.

Type G breakers are available rated: 14.4 kv, 600-1200 amp, with interrupting capacity of 100-250 mva; and 23 kv, 600 amp, 250 mva. Maximum interrupting time: 5 cycles.

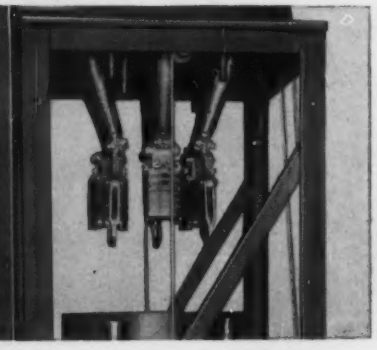
To learn how you can have big-breaker performance in your distribution substation breakers, call your Westinghouse sales engineer. Or, write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-60968

YOU CAN BE SURE...IF IT'S

Westinghouse

Staggered interrupters give complete phase-to-phase insulation. Hinged moving contacts provide positive guiding action . . . simplest operating linkage. Since single-phase faults may occur more frequently on one particular phase, three phases in one tank make optimum use of all of the oil . . . minimize maintenance.

Relays and operating mechanism both located in cabinet of breaker to trim space requirements. Hinged relay panel provides easy accessibility for inspection or maintenance.

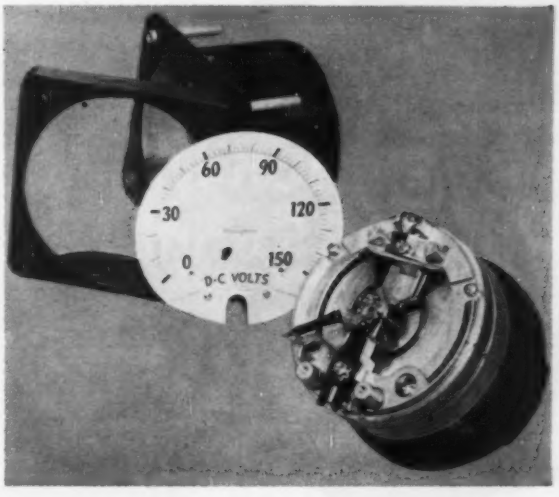


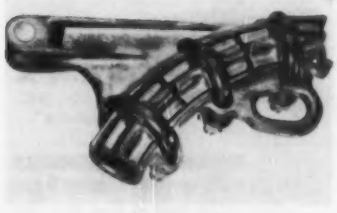
Taut Band Instruments . . .

. . . for switchboard use have no bearings and are completely free of rolling or sliding friction. Moving element is supported by short, hair-like band of special alloy, providing high degree of sensitivity. Full-scale 250-deg deflection is possible with currents down to 50 ma. U-shaped anchoring springs maintain band tension and improve immunity to shock and vibration.

Designated as the KX-241 line, these instruments are shallower and have magnetic circuit which makes them practically impervious to stray magnetic fields. Other features are improved damping factor and reduced maintenance. Line includes d-c ammeters; milliammeters and microammeters; voltmeters and millivoltmeters; frequency meters with transducers; and rectifier-type a-c voltmeters and milliammeters.

Westinghouse Electric Corp, Box 2278, Pittsburgh, Pa.





Bronze Dead Ends . . .

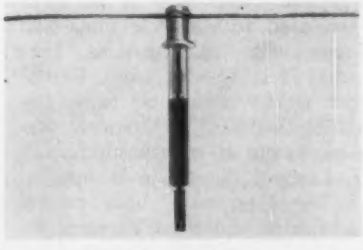
. . . with improved holding power and compactness cover cable range from No. 2/0 to 2,000 Mcm in five sizes. Type BR1 (illustrated) is for single copper cable; BR2 for double cable, in short spans, where compactness and high pulling strength are essential. These lines have silicon bronze U-bolts, galvanized steel clevis bolts, and stainless steel cotter key. Come-along eye permits easy cable sagging with stringing tackle. Cable may be slid under one-piece keeper, or keeper may be removed and cable laid in clamp grooves from the side.

Anderson Electric Corp, Birmingham 1, Ala

10-W Carrier Pilot Relay . . .

. . . is completely transistorized. Designated Type CS-17, this transmitter-receiver unit provides channel for directional comparison relaying or supervisory control and AM telephone facilities. Ten-watt output improves reliability under adverse conditions. Mounted in a standard rack, the equipment is easily accessible for servicing and has provisions for measurement of important voltages and currents with standard analyzer. Equipment can be operated from 48 v dc as well as 125- and 250-v supplies.

General Electric Co, Electronics Park, Syracuse, N. Y.



Load-Pickup Tool . . .

. . . picks up and carries 200 amp at 7.8 kv. Jaw opening accommodates 250-Mcm stranded copper through No. 6 solid copper. Strong compression spring closes the contact plunger with such speed that no are is drawn. High-dielectric, transparent handle simplifies inspection of operating mechanism and checking of contact position, with each use. Tool can be applied or removed with one hand. To reduce weight and improve handling, it has high conductivity aluminum head. Multi-fingered contacts are berylium copper, silvered to prevent overheating.

A. B. Chance Co, Centralia, Mo.

Lineman's Jacket . . .

. . . makes wearer readily visible at night or in stormy weather. Made of yellow, Bakelite Krene, this tough light weight garment is water and wind proof and has 9.6-kv dielectric resistance. It resists acids, oils, and alkalis and will not rot or mildew when stored wet. Jacket fits over outdoor clothing and has attached red parka hood.

Plastimayd Corp., 931 S.E. 6th Ave, Portland 14, Ore.

Electronic Chart Recorder . . .

. . . can record up to four non-linear inputs on one circular chart. Electronic receivers may be differential transformer type, for pressure, temperature, flow, or motion recording; or slide wire type for a-c resistance bridge or d-c potentiometer type circuitry. Directly actuated pressure and temperature re-

The Old Reliable

EVERSTICK ANCHORS...

EXTRA Holding Power
QUICKLY Installed
TOUGH For long life

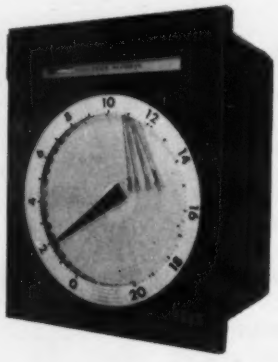
● They speed up work and provide dependable anchorage in new construction and maintenance. Quick and easy to install—made of tough rust-resistant malleable iron—their holding power "tops" all other. Available two-way, three-way, four-way, and cone types. Write for facts.

Exclusive Everstick nut housing Locks anchor firmly on rod. No chance of rod slipping thru anchor.

EVERSTICK ANCHOR CO
FAIRFIELD, IOWA

Electronic Chart Recorder

(*Continued from page 69*)



ceivers are also available. Up to two continuous mechanical integrators are available for totalizing incoming signals.
Hays Corp, Michigan City, Ind.

Secondary Rack . . .

. . . with points staked to back is sturdy and economical. Made of hot-galvanized, pressed steel, it is offered in light type, for light loadings, and medium type, for intermediate loadings. Both types are available with either extended or non-extended back. Rack conforms to E.E.I. standards. **A. B. Chance Co, Centralia, Mo.**

Small Two-Way Radio . . .

. . . can be clipped to belt or carried in pocket. Range is up to two miles when used with mobile units and further with fixed stations. Frequency is in 150-Mc band. Equipment works compatibly with any existing standard equipment. Receiver weighs 10 oz; transmitter, 28 oz. Longest dimension is approx. 6.5 in. Equipment uses carbon microphone and either earpiece reproducer or small lapel speaker.
Radio Corp of America, Communications Equipment, Camden, N. J.

Closed Circuit TV . . .

. . . automatically maintains picture quality with light variations of 12,000 to 1. Designated Type 700-A, this simple, compact system comprises camera, camera control, and video monitor. Readily expandable,

INDIANA STEEL & WIRE CO Crapo Galvanizing MUNCIE, IND

Signs along the lines of Crapo GALVANIZED STEEL STRAND PERFORMANCE

For dependable performance . . . insist upon Crapo Galvanized Steel Strand. Superior tensile strength, combined with long-life, ruggedness and workability, makes Crapo Steel Strand first choice for guys, messenger and overhead ground wire.

The famous Crapo galvanizing process provides dependable protection for the steel, prolongs the expectant life of the strand.

- Low maintenance cost
- Laboratory tested and controlled quality
- Meets highest quality standards
- A size and grade for all practical needs
- Contact your Crapo Jobber Today!

INDIANA
STEEL & WIRE CO., INC.
Muncie, Indiana

THIEL'S Universal HUMP PAT. PENDING NAIL-IT

WRITE FOR FREE SAMPLES

● Essential for Electrical Men

Another FIRST FOR THIEL IN THE NEW HUMP DRIVE NAIL-IT STRAP. THE HUMP HAS A STURDY HEAD TO INSURE EASY-DRIVE WITHOUT BENDING OR PULLING OUT. MADE OF #8 HEAVY WIRE. ZINC PLATING PREVENTS RUST.

COPPER PLATED FOR PLUMBER'S USE — AVAILABLE SOLD ONLY THRU LEADING ELECTRICAL WHOLESALERS.

THIEL TOOL & ENGINEERING CO., INC.
1417 N. MARKET ST. LOUIS 2, MO.

it includes accessories for remote controlled pan and tilt mechanism; selection of up to four cameras with single control unit; special enclosure in extreme environmental conditions; remote optical focus; and remote controlled lens turret or variable focus lens. Camera may be operated up to 500 ft from control; monitor may be 1,500 ft from control without use of amplifiers.
International Telephone & Telegraph Corp, 15191 Bledsoe St, San Fernando, Cal.

Cylindrical Light Bulb . . .

. . . provides soft, glareless light with no loss in total light output, through use of special silica coating. Although outer dimensions are no greater than ordinary bulb, this unit has greater surface area, better light distribution, and less surface brightness. Initially, they are available in 60, and 100-w sizes.
Westinghouse Electric Corp, Bloomfield, N. J.

Water-Cooled Brushes . . .

. . . for low voltage, high ampere applications have longer life. These metal-graphic brushes are used on ring and commutator applications for contact rolls on plating lines and homopolar generators. Continuous tube, molded in top portion of brush, carries water through brush structure, to produce cooling effect. In low humidity applications, system may be used as source of humidity by metering specified amounts of water from tubing to brush itself.
Keystone Carbon Co, St Marys, Pa.

Addendum

Transformer Coolers . . .

. . . can handle 5 gal of oil per kw. Coolers of this capacity are now standard equipment on the forced-oil-cooled power transformers produced by Westinghouse Electric Corp, as indicated in the article entitled "Transformer Coolers," in the June 2, 1958 issue of Electrical World, page 78.

Is YOUR Brush Control Problem "Different"?

WHATEVER YOUR PROBLEM, YOU'LL FIND THERE'S A

WEEDONE®

BRUSH KILLER

specially designed to do the job

Chemical control of brush—for line and roadside clearance and other purposes—has come a long way in a few short years. Weedone Brush Killers, originated by the American Chemical Paint Company, were the pioneers in chemical brush killing. Now immensely diversified, these fine products are still the leaders in the field. Today there is a Weedone Brush Killer specifically formulated for practically every need. Each is selective, effective, completely reliable.

Whatever your brush control problem, there is a Weedone Brush Killer of superior quality

- for practically every purpose
- for every condition of use
- sure in its kill of even the toughest weeds
- laboratory tested
- field proved over thousands of miles of rights-of-way
- economical to use

Write for Weedone Brush Killer folders and full information.

AMERICAN CHEMICAL PAINT COMPANY
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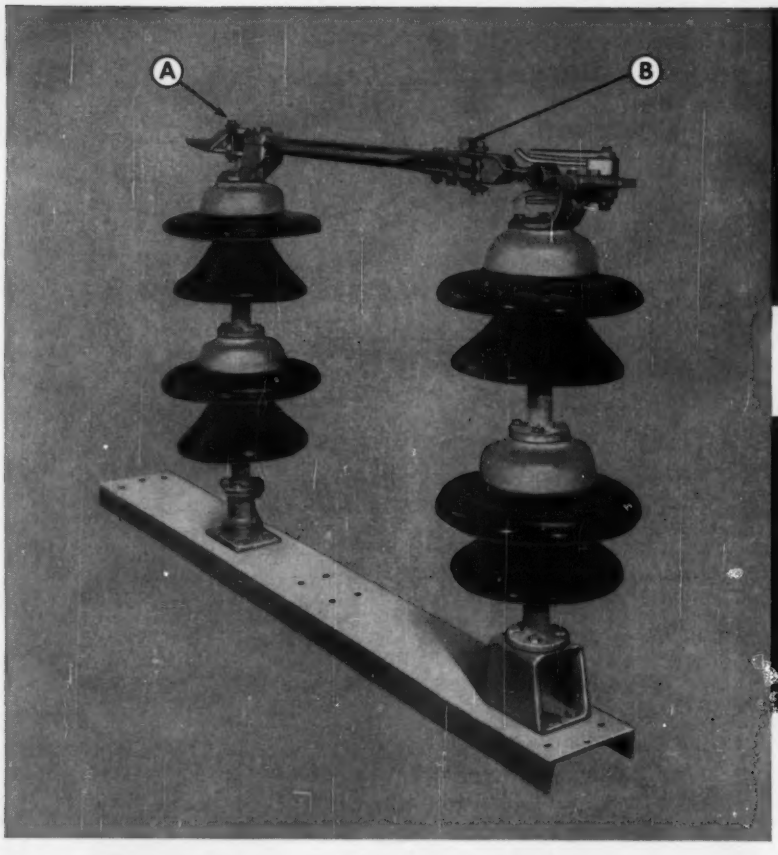
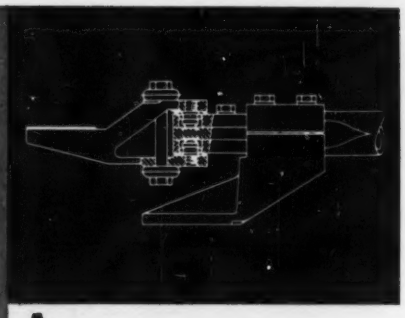
St. Joseph, Mo. • AMBLER, PA. • Niles, Calif.

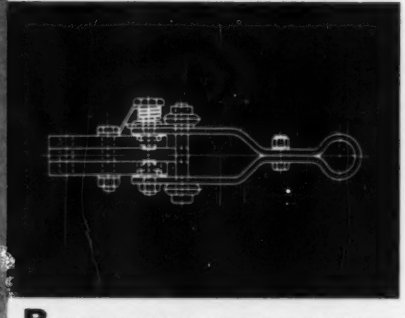
WEEDONE ACP WEEDONE

Originators of 2,4-D and 2,4,5-T Weed and Brush Killers





A NEW-DESIGN SWIVEL TERMINAL. With pressure right on center of rotating insulator, swivel operates with exceptional ease to prevent torsional resistance from line wires.



B KNEE-BREAK BLADE CONTACT provides high-pressure toggle action without putting extra burden on swivel terminal. Maximum operating ease is assured with this combination of swivel and blade contact.

GET MAXIMUM EASE OF OPERATION WITH PMB-40 BRAIDLESS SWITCHES

high-pressure contacts... minimum space requirements

Delta-Star Braidless Side-Break Switches bring the advantages of the popular MK-40 vertical-break switch to applications where ground space and overhead clearances are limited.

Braidless swivel terminals operate with the high-pressure joint directly on the center line of rotation, eliminating drag on conductors during switch operation. Knee-break blade principle provides easy entrance and withdrawal of blade from high-pressure contacts. Large deflections, as on the MK-40, assure uniform, long-life contact pressure.

Ratings are available from 7.2kv to 161kv in 400, 600, and 1200 amperes, with load-interrupting and arc-suppressing attachments on ratings to 69kv. Other horizontal-break models made with center break and double side break.

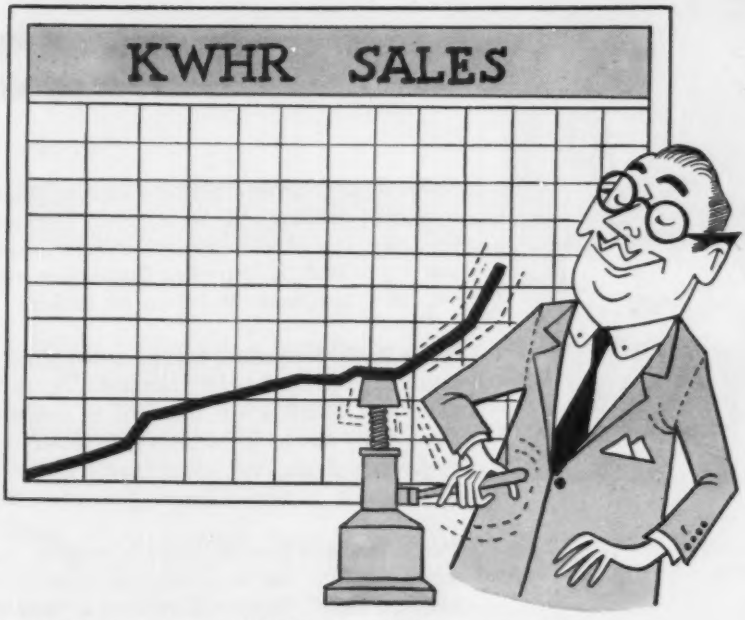
Call your Delta-Star representative or write for Publication 5604. *Dept. 12B, Delta-Star Electric Division, H. K. Porter Company, Inc., 2437 Fulton Street, Chicago 12, Illinois. District offices in principal cities.*

H. K. PORTER COMPANY, INC.

DELTA-STAR ELECTRIC DIVISION

Connors Steel, Delta-Star Electric, Disston, Forge & Fittings, Leschen Wire Rope, Quaker Rubber, Refractories, Riverside-Alloy Metal, Vulcan-Kidd Steel, H. K. Porter Company (Canada) Ltd.

Report on
Area Development



To jack up sales and help the whole community . . .

110 Utilities Push Area Growth

Area development is growing up. The utility industry jumped into area development work after World War II, and in 1949 there were 21 companies with active programs. By 1957, the number had increased to 110—or about 25% of the investor-owned companies listed in the "Directory of Electric Utilities."

This growth is not surprising. A utility cannot pack up its poles and move if business stagnates in its service area. If it is to prosper, its area must attract new industry. If it is to sell more kwhr, someone must buy them.

Area development is more than a way to jack up kwhr sales, however. It is public relations at its best—cooperation with the community for mutual benefit. For an area development program helps the entire community. Every 1,000 jobs brought into an area by a new industry bring also: 1,150 additional jobs in service and supporting industries; a market for 700 homes; purchasers for the output of 250 farm workers; customers to support 40 retail merchants; and $100,000 in extra tax revenue.

Today, utilities have earned a reputation for fine plant location service, with a network of companies offering this service stretching from coast to coast. And some are going one step deeper, helping the towns in their territory to become more attractive to industry through community development programs.

Here are highlights of three companies' area development activities. Connecticut Light & Power Co provides a good example of an active and successful program carried on with a staff of four—with the cooperation of district personnel and industrial real estate brokers. Hawaiian Electric Co demonstrates the start of an

industrial development program under difficult conditions. From Interstate Power Co comes a grass-roots example of community development. Many other companies could also be cited for excellent area development programs.

'It Pays to Work with the Broker'

Connecticut Light & Power Co uses an efficient plant site service program to help bring industry to its service area. Disdaining area development advertising, the company builds its program around cooperation with other agencies whose aim it is to bring industry into Connecticut and with industrial real estate brokers. Most prospects come from the brokers.

In the highly-competitive industrial real estate game, keeping the brokers' confidence requires considerable tact and a reputation of absolute integrity. Brokers know that CL&P is not interested in competing with them, but working with them. They like to do business with CL&P because they know they will not be by-passed—if his deal falls through, the broker knows the prospect was not influenced by any favoritism on the part of the electric company.

Here's how this part of CP&L's program works. District personnel take an active part in it. Industrial sales engineers in the field let the Area Development Manager know whenever a building in their district is about to be vacated, or whenever an industrial site opens up. One of the AD staff then goes to the site, evaluates it, gets detailed data including pictures, and talks to the owner to make sure he wants it promoted. All data is catalogued at the office. This detailed information is then winnowed down, and the essentials are put into a one- or two-page bulletin which is circulated to industrial real estate brokers—local, in Boston, and in the New York metropolitan area.

When the broker tells the electric company that he has a prospect, the area development men and local district personnel—who are more familiar with the site and the community than the broker can be—escort the prospect to the sites in which he is interested. CL&P prefers that the broker go along, but he need not. Company personnel will take care of the selling job.

CL&P's site service goes beyond the point of sale. Not interested in headlines, the company is happy to let the State Development Commission and local chamber of commerce get into the act before the deal is closed—state and local agencies can render real service, and working with local people gives the new firm a good start in community relations. But CL&P continues to follow through on its site service long after the deal is closed, offering aid and advice on such problems as financing, zoning, and even recruiting of personnel.

A testimonial to this service program is the fact that Connecticut L&P has received many "walk-in" prospects—representatives of firms that want to relocate or expand and "have heard CL&P has a good plant site service." These fruits of unsolicited word-of-mouth advertising are gratifying to the electric company, but require delicacy in handling to retain the important broker relationship. When asked to recommend a good broker, CL&P recommends four or five—and not always the same ones.

Another foundation stone of CL&P's area development program is cooperation with other agencies seeking to bring industry into the state. The company has joined with other utilities, railroads, financial institutions, and the State Development Commission in forming the Connecticut Industrial Development Coun-

cil—a model marriage of business and government in which all agencies with area-wide activities join forces and share the cost of promotional projects.

CL&P contributes both manpower and dollars to developing Connecticut. Company Vp Paul V. Hayden has been active in industrial development since the mid-'30's, and helped found the Connecticut Development Commission; and Robert P. Lee, CL&P's Area Development Manager, is just winding up three years as chairman of the commission. In addition, Connecticut L&P invests in the Connecticut Development Credit Corp and local industrial foundations.

Tourist Paradise Beckons to Industry

Industrial development is beginning to get underway in the Hawaiian Islands, in spite of handicaps that might make a Mainland area development man shudder. When Hawaiian Electric Co formed its Industrial Development Section three years ago, these were the problems it faced:

- **How do you persuade a booming, resort-oriented community** that it needs to diversify its employment and broaden its tax base?
- **How do you persuade Mainland industry** to build plants in a location that lacks industrial know-how and experience, and is separated from the continental market by 2,000 miles of ocean?

HECo's solution to both problems is keyed to the Islands' bright future and the population explosion of the last decade. This explosion showed the need for more jobs and more taxes to support expanded schools. It also showed that there is a growing local market in the Islands.

HECo started the ball rolling by retaining Stanford Research Institute to examine opportunities for manufacturing industries to locate on Oahu. Although the Institute's optimistic report was greeted with some skepticism, HECo arranged to establish one of the industries recommended—a TV picture-tube plant to serve a local replacement market of 10,000 tubes a year, with prospects of electronics maintenance and repair work for Oahu's large defense establishment.

California know-how and capital, melded with Hawaiian risk money, resulted in 1956 in Kentron-Hawaii Ltd, a $¼-million enterprise with more than 30 employees, nearly all originally Island residents.

This set the pattern: A combination of Mainland know-how and limited Mainland capital with Island capital, working together to serve promising local markets. Today the fortunes that were built up on sugar, pineapples, and shipping are probing the opportunities unearthed by the Stanford report.

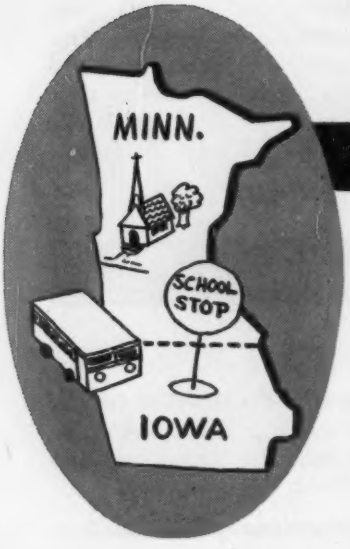
HECo continues to provide leadership for Island development. In addition to catalyzing several business and government activities aimed at economic growth, the utility is working on two projects of its own: The Islands' first plastics extrusion plant and a semi-integrated steel mill.

The plastics plant will extrude polyethylene strip for mulching pineapple plants and other farm products. It will displace paper now imported for mulching, and will also supply material for export carton liners for frozen juice concentrates. Local uses are also expected to develop.

The steel mill will use local scrap to make reinforcing rod for Island construction. It could displace Mainland imports for a market of 12-20,000 tons per

year and would initially employ upwards of 30 workers. HECo believes the mill will become a reality this year.

It will take from three to five years more of intensive effort to clear away roadblocks to progress, but HECo sees good promise of ultimate success.



Towns Lift Themselves 'By Boot-Straps'

Interstate Power Co has established its own community development program, and has tailored it to fit conditions in the small towns that predominate in the company's service area. Although the program is young, 60 towns are active in it; and several of these have already shown some outstanding results.

The program has a three-fold purpose: To make the town a better place to work and live; to attract small business and industry; and to help local businesses and industries to expand.

Before trying out its program, IPCo surveyed all towns in the area. District managers rounded up such information as: names of key men in town, the community's spirit, its problems, its appearance, and the facilities available. IPCo decided to push community development only in towns with both a need and a desire to improve themselves, and only where the company's public relations were already good. Here's an example of how Interstate's community development program has worked in one such town.

Swea City, an Iowa farm town with population 869, was chosen as a test case, because of the remarkable spirit manifested by its merchants. IPCo's Community Development Committee met with leaders of the town, won their approval, and left them a brochure containing complete information for running the program and worksheets for rating the town. Then IPCo stepped into the background. With the aid of the brochure and worksheets, community leaders set about determining the town's needs, and organized a council to meet them.

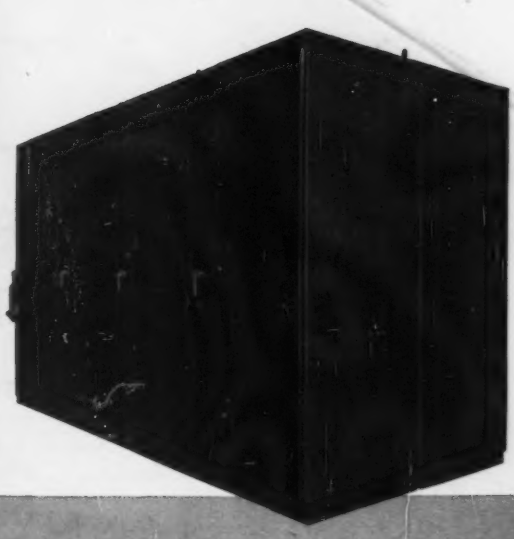
Each organization in the town and surrounding rural trade area was asked to appoint a representative to serve on the Community Development Council. Special attention was given to enlisting two or three farmers. Then action committees and an executive committee were chosen. Action committees used the forms provided in the brochures and made surveys to determine the town's needs.

Finding that the town's most pressing need was for a doctor and a dentist, the council adopted a $20,000 modern health center as its first project. It formed a corporation, "Our Town Building, Inc," and sold stock certificates in $25 denominations to finance its construction. When the center was completed, the council interested a doctor and a dentist in settling there. The council also helped a small manufacturer of fishing lures to expand his operations. And Swea City's community developers are still going ahead, full blast.

Other notable results of Interstate's program have been new industries attracted to Clinton, Iowa, and Albert Lea, Minn.; and housing developments, street improvements, and recreational facilities elsewhere.

The ultimate object of the program is to attract industry, but Interstate Power Co and the towns in its program realize that community development must precede industrial development. To this end, the company will continue to present the program to more towns. Interstate expects its towns to grow and prosper; and Interstate expects to grow and prosper with them.

for high voltage service continuity on your critical loads at lower capital outlay— it's S&C Metalclad Switchgear!

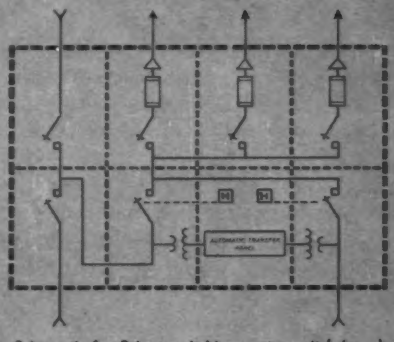


To get service continuity on critical loads, you need preferred-to-emergency switching of your alternate incoming high-voltage supply circuits, and short-circuit protection and switching on your outgoing high-voltage supply feeders. All of this can be provided in one low-cost package in S&C Metalclad Switchgear, as illustrated.

You even have built-in choices of throwover schemes through S&C's standard automatic transfer panels.

You save two ways:

1. You get metalclad switchgear with job-matched load interrupters and power fuses, in lieu of costly circuit breakers.
2. You eliminate cost of custom designing by using an off-the-shelf transfer panel with built-in options.

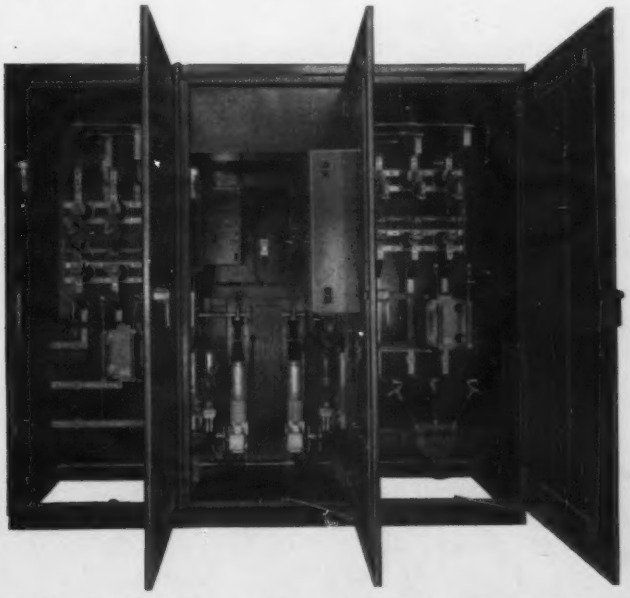


Schematic for 8-bay switching center unit (above) shows throwover control of 2 of 3 alternative incoming sources to provide continuous service for three outgoing feeders.

No organic insulation to cause corona trouble; porcelain and air only.

High-Speed Automatic Switching.

Full-length bulkhead doors; rainproof, with complete access.



Super Durabake finish with galvanized and stainless steel hardware; withstands corrosive atmospheres.

Separate compartment for Moto-Draulic operators; free access and decoupling for checkout.

Strip heaters with adequate venting prevents moisture accumulation.

S&C Standard Automatic Transfer Panel provides for making either source preferred, for automatic or manual return, for adjustable time delays, for choice of returning in either open or closed transition, and for optional lockout on bus faults.

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. . . SINGLE RESPONSIBILITY WITH WESTINGHOUSE UNIT SUBS

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Shelterfor-M metal-clad switchgear provides all-weather maintenance protection for your switchgear . . . encloses common operating and drawout aisle. Eliminates front and rear doors, need for expensive concrete pads and unsightly temporary structures. The compact design saves valuable real estate.

You can be relieved of time-consuming engineering and purchasing details in building your next substation . . . and receive the counsel of Westinghouse regional application engineers and product specialists, headquarters system planners and local equipment installation and field service engineering by calling your Westinghouse sales engineer. For more information, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

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WESTINGHOUSE UNIT SUBS MAKE GOOD NEIGHBORS

Shelterfor-M switchgear does not require concrete service and drawout pads, allowing grass and shrubbery to be planted right up to the walls. Clean, modern lines make this substation unobtrusive in residential areas.

Extensive research in the Sharon half-million-dollar sound labs has produced a substation transformer that is the leader of the industry for quiet operation. Here is a combination of pleasant appearance and quiet performance that makes Westinghouse unit subs *easy to live with.*

YOU CAN BE SURE...IF IT'S

Westinghouse

With Shelterfor-M switchgear, your maintenance schedule can be carried out regardless of weather — no more rainy-day delays. When necessary, emergency servicing can be done without tarpaulins or other makeshift shelters.

↓

General Electric Co photo

Heat Pumps Save School $6,000

What is reportedly the world's first heat pump packaged air conditioned school will go on Virginia Electric & Power Co's lines this coming September.

Thirty-six packaged heat pumps will automatically comfort-condition youngsters in the 24-classroom John B. Cary elementary school at Hampton, Va. Rated at three tons apiece, they represent a connected load of approximately 150 kw.

The heat pumps offered the Hampton school board some hard-to-resist features. First, their installation will put $6,000 in the school board's pockets that would have been spent if conventional methods had been used. Second, the air conditioning feature of the heat pumps allows the school facilities to be used during the summer and other off-school periods. This will, in part, alleviate the tight situation arising from the lack of sufficient school facilities in the area.

Team Up Insulation and Controls . . .

. . . on residential space-heating equipment to help regulate daily peak demand

KARL K. HICKMAN, Supervisor, Air Conditioning Dept, Florida Power Corp, St. Petersburg, Fla.

Five years' experience has shown Florida Power Corp, St. Petersburg, that strict regulations on insulation and controls used with home residential space-heating equipment are a successful means of regulating daily peak demand.

Florida Power makes provisions for adding $1 per connected kw to the bills of space-heating customers who do not meet the utility's recommendations as to building instruction, insulation and installed capacity, or who do not install controls that automatically cut off heating units during peak hours. Charge has been in effect since August, 1953.

The company recommends 6 in. of mineral wool or equivalent ceiling insulation for ceiling cable installations and 4 in. for heat pumps and other types of resistance equipment.

With a 5-to-1 ratio between annual cooling and heating hours, Florida Power promotes heat pumps rather than resistance units. As of March 31, it had 4,899 residential heat pumps on its lines—1,298 central units and 3,601 room units. Resistance heating customers numbered 2,430.

Commonwealth Ed Goes After Electric Heat Load

Commonwealth Edison Co of Chicago is going to start promoting electric space heating. J. H. Ward, executive vice president, told stockholders at the annual meeting that this is "perhaps the most exciting of our new promotions."

Commonwealth Edison has been so taxed to meet the electric load for industrial and other residential purposes that up to now it hasn't pushed sales of electric heating.

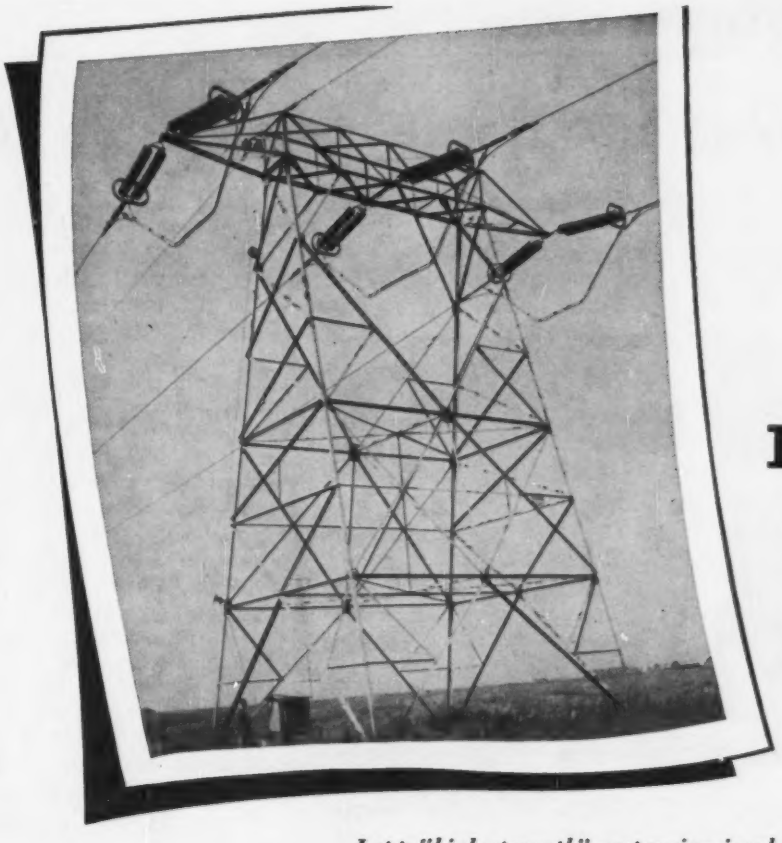
This year, however, Commonwealth Edison will add to its system 815,000 kw of new generating capacity—largest in its history. And the system is reinforced by the interchange with American Electric Power. "With all this additional capacity, we expect to have an adequate reserve for the first time since World War II," said Ward.

LILCO Quits Merchandising

Long Island Lighting Co went out of the appliance merchandising business on July 1, according to Sales vp W. O. Smith. Main reason is a change in policy in favor of supporting dealers, rather than competing with them. Said Smith: "LILCO is going out of the retail selling of appliances in favor of the local merchant who is qualified to give the consumer what he wants."

PRODUCT PREVIEWS

York Corp has begun production of an improved **15-ton packaged air conditioner** said to deliver a full 180,000 Btu . . . Electromode is wooing the blossoming electric school heating market with two new **companion classroom heating and ventilating units.** Company says they're flexible, easily controlled, and capable of "screwdriver" maintenance . . . General Electric winding up tests on its **reverse air cycle "Thermaline" heat pump,** with marketing pegged for sometime during 1959.



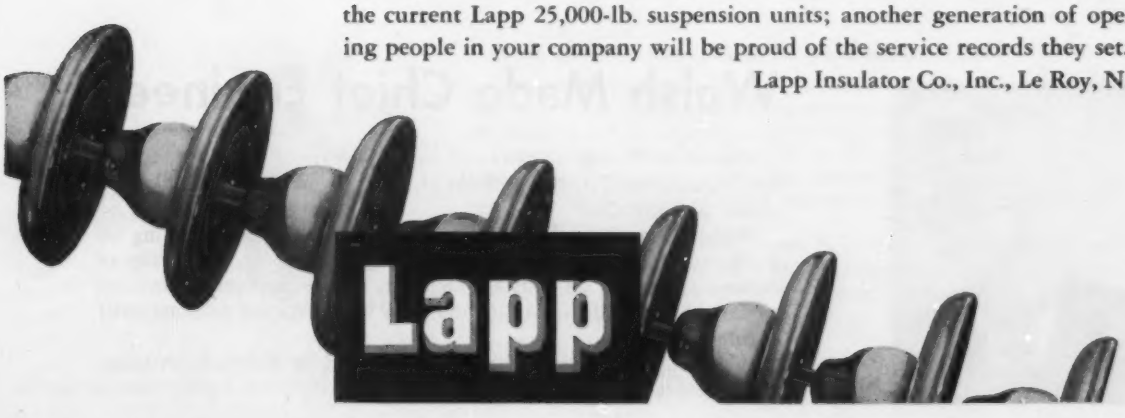
In 1923 this was EHV

Lapp "high strength" suspension insulators were used by Southern California Edison Co. for its 220 kv Eagle Bell line. Erected in 1923, this line is now in its 35th year of service. Original insulators are still in place. Company reports "no trouble"; total replacement of insulators for all causes over 34 years is "less than 1%."

"Design for electrical security and long life—then do all you can to make it strong." This has been a Lapp principle from the beginning. In 1923, when the line shown above was erected, the insulators on it were cataloged as 18,000-lb. units—at a time when the industry was talking generally of 9,000-lb. and 12,000-lb. units. Before, and since then, Lapp has pioneered in insulators that combine long life with high mechanical strength.

For your EHV and other high-mechanical-loading requirements, specify the current Lapp 25,000-lb. suspension units; another generation of operating people in your company will be proud of the service records they set.

Lapp Insulator Co., Inc., Le Roy, N. Y.



Herbert, Carpenter Advance at Minnesota P&L

The promotion of Axel H. Herbert to vice president and general manager, and Hubbell Carpenter to vice president and chief engineer has been announced by Minnesota Power & Light Co.

Herbert, who has been with the power company since 1926, has been promoted to positions of ever-increasing responsibility during his MP&L career. He is a former manager of the utility's Little Falls division and assistant to the general manager at the Duluth home office. In 1957 he became vice president and assistant general manager.

A. H. HERBERT

H. CARPENTER

In his new capacity, Herbert assumes part of the managerial duties formerly shouldered by Clay C. Boswell, president, who had also been general manager until Herbert's promotion.

Carpenter, an engineering graduate of the University of Idaho, joined the ranks of the utility in 1944, and for the past five years has served as chief engineer.

He has directed the construction of Minnesota's two 44,000 hp generators at Duluth's M. L. Hibbard plant; and most recently, the 120,000 hp development at Aurora.

Johnson Upped To VP

Southern Nevada Power Co has named Elmer F. Johnson vice president, operations. He succeeds D. D. Smally, retired.

After graduating from Oregon State College, Johnson teamed up with Stone & Webster Service Corp, helping to manage its electric properties in Chile for 12 years, until 1942. He joined the Army Corps of Engineers in 1942, performing public utility and technical duties, and rose to major during the war.

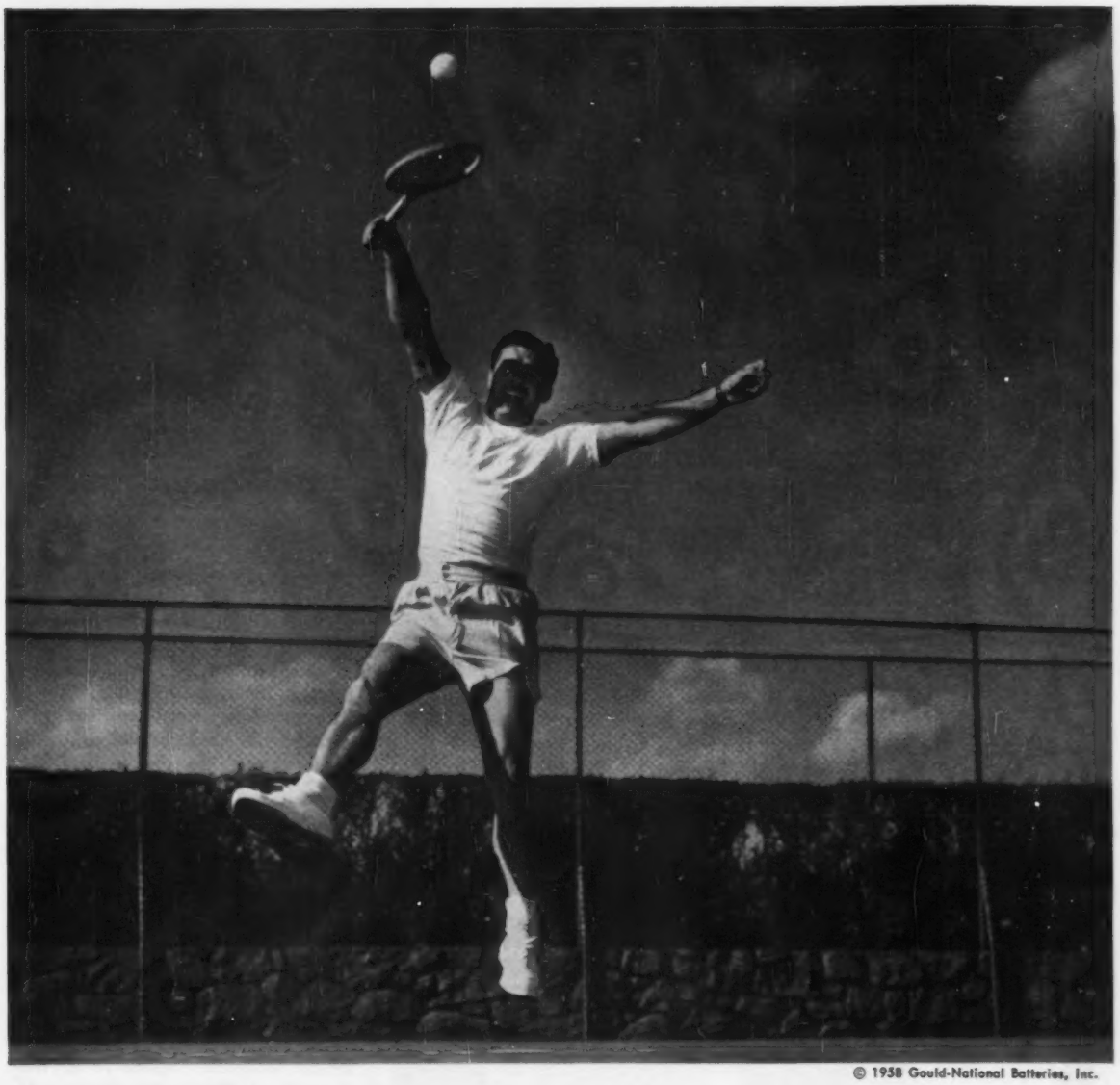
Following his Army service he joined the American & Foreign Power Co, and from 1948 to 1955 was president of its Brazilian Service Co, the position he held before coming to Southern Nevada.

Walsh Made Chief Engineer

Carroll H. Walsh, a veteran of over 30 years of company service, has been elevated to the position of chief engineer by the Arkansas Power & Light Co.

Walsh began his AP&L career in 1927, immediately following his graduation from the electrical engineering department, University of Arkansas. Initially an assistant engineer, he was appointed electrical engineer by the utility in 1936, and in 1956 was named assistant chief engineer.

Walsh steps into a position previously held by Ralph R. Pittman, vice president, engineering and production.



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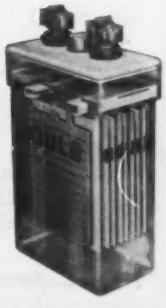

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Wheeler Made Purchasing Agent

Ronald R. Wheeler has been named purchasing agent by Dayton Power & Light Co.

Wheeler came to Dayton P&L in 1935, serving first as a bookkeeper, and in 1936 joined the utility's purchasing department. Time out for World War II saw him enter the Army's OCS program, where he won his commission. He served with the Quartermaster Corps in Europe from 1944-46, and in 1946 was discharged as captain.

Back at Dayton P&L, Wheeler once again entered the purchasing department, and in 1948 was made assistant purchasing agent.

PERSONAL BRIEFS

Norman R. Sutherland, president of Pacific Gas & Electric Co, has been named "California Industrialist of the Year 1957" by the California Museum of Science and Industry.

O. L. K. McKibben, assistant comptroller-manager of accounting for West Penn Power Co, has been elected treasurer of the company at its general office in Greensburg. He succeeds **E. S. Haymond,** who will retire soon.

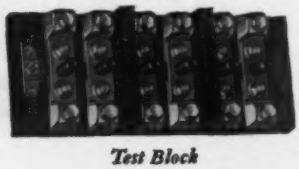
Five Detroit Edison Co engineers, currently on loan to Atomic Power Development Associates, have been named to the Power Reacter Development Co staff that will operate the reactor section of the Enrico Fermi Atomic Power Plant. **William C. Morrison** will be operating engineer; **Orville E. Homeister,** technical engineer; **Richard G. Ratick,** assistant technical engineer, and **William F. Colbert** and **Eugene H. Newton,** will be shift engineers.

Clyde H. Bielstein, educational director for Dayton Power & Light Co, has been elected president of the Western Ohio chapter, American Society of Training Directors.

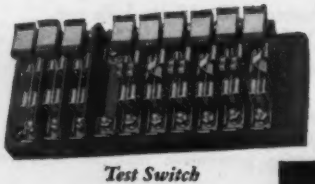
Dale Hiscock has been named superintendent of Consumers Public Power District's Tobias, Nebraska, area. He succeeds **George Lang,** promoted to superintendent of the Valentine sub-district in Northwest Nebraska.

James E. Smyth has been appointed director of merchandising on Kelvinator and Leonard electric appliances.

Look to Superior for
TEST SWITCHES AND BLOCKS



Test Block



Test Switch

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Catalog 55 offers complete information on features, services, type and sizes. Write to:

Analog or Digital?

(*Continued from page* 58)

upon the number of cases in the study and how they are grouped, the number of engineers involved in the study, and how quickly they can review results of preceeding cases. It is foreseeable that a group of cases could be solved and returned to a customer within two weeks.

Ownership of a digital computer by an electric utility, of course, eliminates the time a study is in the mail. But whether the computer is installed for purely engineering studies or for non-engineering work as well, the time for a load flow problem must be scheduled so as not to interfere with other uses.

Ownership of a network calculator by the utility affects the evaluation in several ways: The cost per day is less because of different rates of write-off, capitalized rates, and elimination of travel and out-of-town expenses. The calculator may be used to study distribution and subtransmission problems, or to train personnel. These uses reduce the unit cost per study on the calculator. The facility is readily available for the set-up of urgent problems, and with the system in the set-up condition, preliminary time is minimized.

It should be pointed out that planning studies are several studies in one and consist of making various changes from the initial specifications to obtain an acceptable basic system. With the network calculator, partial readings can be taken in these studies to record successive changes on only part of the system.

The direct analog basis of the network calculator gives the engineer a better visualization of what is taking place on the system and how it responds to changes. While this advantage will change as more experience is gained with digital computers, it will always remain as an advantage of the network calculator, both in direct use and in the training of personnel.

To summarize for the future of both methods, the authors feel that network calculators and digital computer studies will enjoy greater usage in the solution of load flow problems. The former will be used largely in utility-owned installations and the latter on a rental or service bureau basis.

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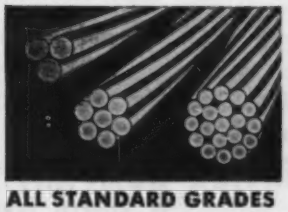

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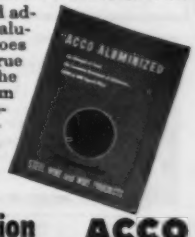

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The Meetings Calendar

JULY

Oklahoma Utilities Association—Accounting Section Conference, Ardmore Hotel, Ardmore, Okla., July 18.

Western Summer Radio-Television & Appliance Market—Western Merchandise Mart, San Francisco, Calif., July 21-25.

AUGUST

Southeastern Electric Exchange Public Utility Executive Course—Georgia Institute of Technology, Atlanta, Ga., Aug. 4-29.

American Institute of Electrical Engineers—Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, Hotel Statler, Los Angeles, Aug. 6-8; Pacific General Meeting, Sacramento, Calif., Aug. 19-22.

The Institute of Radio Engineers—Conference on Electronic Standards and Measurements, NBS Boulder Laboratories, Boulder, Colo., Aug. 13-15.

Illuminating Engineering Society—National Technical Conference, Royal York Hotel, Toronto, Canada, Aug. 17-22.

SEPTEMBER

Edison Electric Institute—Accounting Division and Section Organization Meeting, sponsored jointly with AGA, Netherland Hilton Hotel, Cincinnati, Ohio, Sept. 8-9; Industrial Power & Heating Group, Wisconsin Dells, Wisc., Sept. 18-19; Meter and Service Committee, Driscoll Hotel, Corpus Christi, Texas, Sept. 22-24.

• **Northwest Public Power Association, Inc**—Power Use Section Annual Meeting, Malaspina Hotel, Nanaimo, British Columbia, Sept. 10-12.

Maryland Utilities Association—34th Fall Conference, The Cavalier-Sir Walter Raleigh Hotels, Virginia Beach, Va., Sept. 12-13.

Rocky Mountain Electrical League—Annual Fall Convention, Jackson Lake Lodge, Moran, Wyo., Sept. 14-17.

American Institute of Electrical Engineers—Power Industry Computer Application Conference, King Edward Hotel, Toronto, Canada, Sept. 15-17.

• **Instrument Society of America**—13th Annual Instrument Automation Conference & Exhibit, Philadelphia Convention Hall, Pa., Sept. 15-19.

World Power Conference—Sixth International Congress on Large Dams, Statler Hotel, New York City, Sept. 15-20.

• **Pennsylvania Electric Association**—51st Annual Meeting, Penn Sheraton Hotel, Pittsburgh, Pa., Sept. 17-18.

Northwest Electric Light & Power Association—51st Annual Meeting, Sun Valley Lodge, Sun Valley, Idaho, Sept. 17-19.

Public Utilities Association of the Virginias—40th Annual Meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., Sept. 18-21.

• **American Society of Mechanical Engineers**—Power Division Conference, Hotel Statler, Boston, Mass., Sept. 28-Oct. 1.

OCTOBER

• **Indiana Electric Association**—Annual Convention, French Lick-Sheraton Hotel, French Lick, Ind., Oct. 1-3.

• **Electric Companies Public Information Program**—Workshop Conference, Radisson Hotel, Minneapolis, Minn., Oct. 1-3.

• **Edison Electric Institute**—Prime Movers Committee, Hotel Statler-Hilton, Buffalo, N. Y., Oct. 6-8; Transmission & Distribution Committee, Hotel New Yorker, New York City, Oct. 9-10; Electric System and Equipment Committee, Hotel Barringer, Charlotte, N. C., Oct. 13-14; 5th Annual Area Development Workshop, Hotel Somerset, Boston, Mass.; Taxation Accounting Committee, co-sponsored by AGA, Tides Hotel and Bath Club, St. Petersburg, Fla., Oct. 22-24.

• **Wisconsin Utilities Association**—Electric and Gas Operations & Sales Convention, Schroeder Hotel, Milwaukee, Wisc., Oct. 15-17.

• **Oklahoma Utilities Association**—Electric Light and Power Division Conference, Eastern District, Western Hills Lodge, Lake Sequoyah, Wagoner, Okla., Oct. 16.

• **Pennsylvania Electric Association**—Prime Movers Committee, Skytop Lodge, White Haven, Pa., Oct. 16-17.

• **Southeastern Electric Exchange**—Engineering & Operation Section, Hotel Roanoke, Roanoke, Va., Oct. 20-21; Accounting Conference, Roosevelt Hotel, New Orleans, La., Oct. 30-31.

• Additions this week.

MORE BIG DATES FOR '58

Edison Electric Institute—Industrial Relations Committee Round Table Conference, Hotel Drake, Chicago, Ill., Sept. 29-Oct. 1.

National Electrical Manufacturers Association—Annual Meeting, Atlantic City, Nov. 10-14.

National Association of Railroad and Utilities Commissioners—Annual Convention, Westward Ho Hotel, Phoenix, Ariz., Nov. 17-20.

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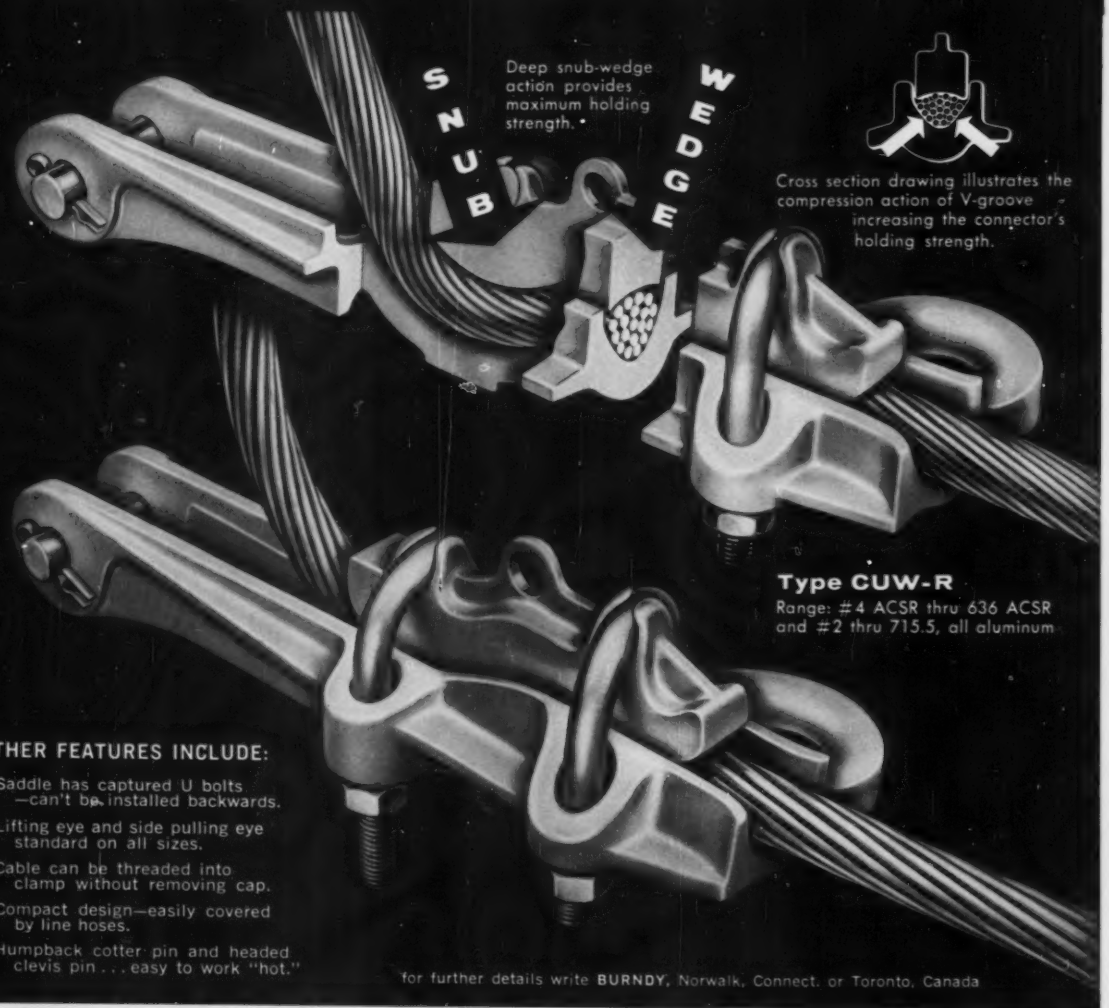

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58-7

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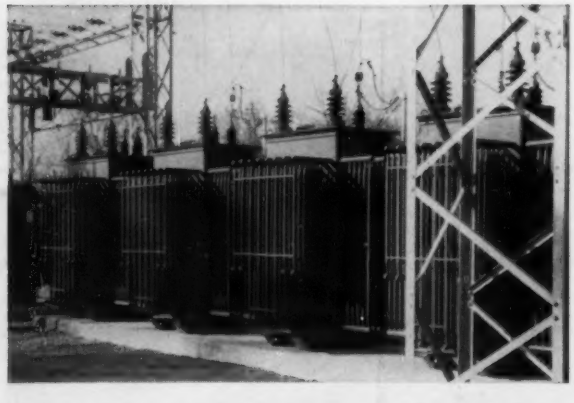

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"We are also impressed with their height, which solves our problem of maintaining required ground clearances.

"Then, too, delivery was according to schedule which, in itself, is no little consideration."

This installation of three Kuhlman single phase power transformers, plus a spare, serves the growing rural and small industrial community of Doswell, Virginia. Although some of the load is polyphase, single phase units are used rather than three phase to give greater versatility for serving the system's single phase farm and residential lines.

Like Mr. Brown, you'll find Kuhlman small power transformers meet all your requirements — especially those features important to you.

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